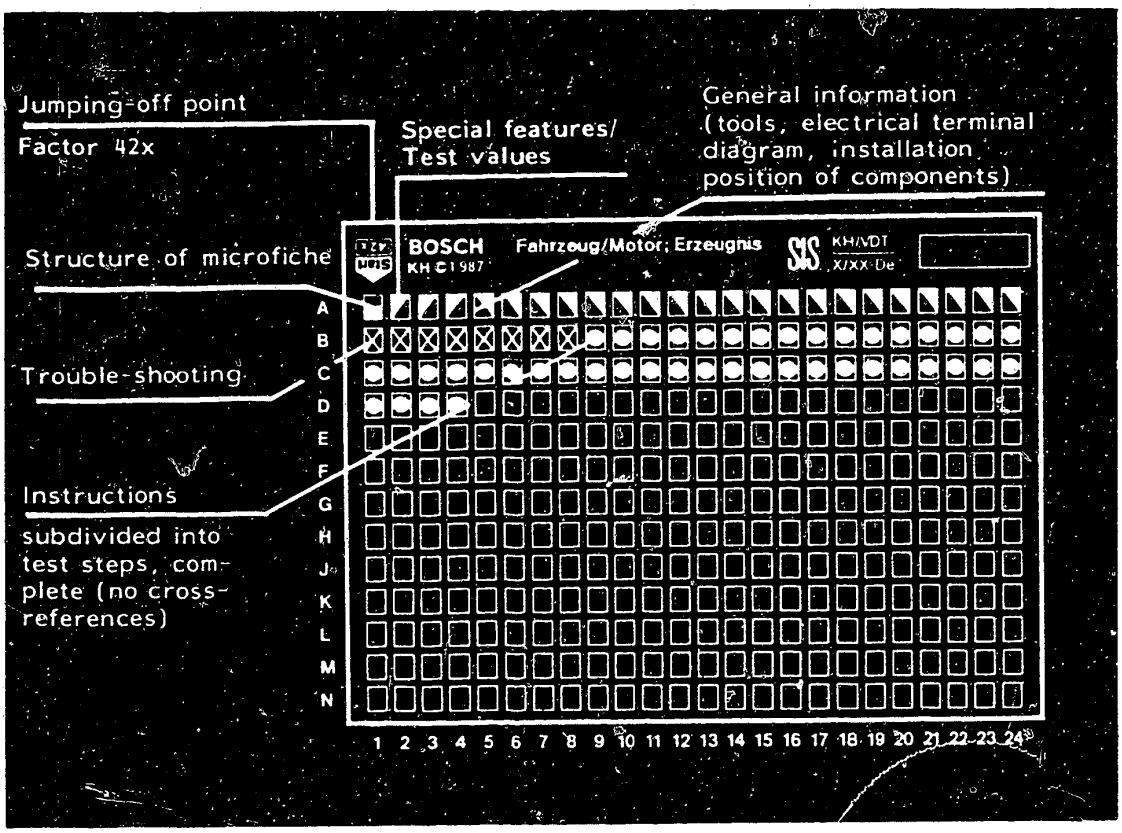
Structure of microfiche



1. Read from left to right

2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section



Beginning Mid-section End One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6

C6

A1	Trouble-shooting program	↓

1. Special features

190 E 2.3 - 16, 4-cyl. engine 102.983 as of year of manufacture 1984, worldwide excluding USA, J, AUS (with transmission-overload protection on automatic transmission).
Equipped with:
EI control unit 0 227 400 508, ..636 (with current limitation) or
Siemens AG control unit (Daimler-Benz AG service part).
Note: Bosch and Siemens control units are interchangeable.
Ignition coil 0 221 5..

2. Test specifications

Ignition coil, primary Ignition coil, secondary	0.3 ... 0.6 Ω 7.3 ... 13.2 kΩ	B 11
High-voltage-distributor setting	Cyl. 1 at high-voltage-distributor TDC marking	B 13
Contact resistance, supply leads from EI control unit and primary circuit	max. 0.3 Ω	B 15
Transmission-overload--protection switch (automatic transmission only) Driving position "N" or "P" Driving position "D"	 > 20 kΩ < 1Ω	B 17

B23

Coolant-temperature sensor	+ 20°C	2.1 ... 2.9 kΩ	
	+ 30°C	1.4 ... 2.0 kΩ	
	+ 80°C	280 ... 370 Ω	
	+ 90°C	210 ... 280 Ω	
	+ 100°C	160 ... 215 Ω	

C1

Trimming-plug position	1 =	∞ Ω
	2 =	2.4 kΩ
	3 =	1.3 kΩ
	4 =	750 Ω
	5 =	470 Ω
	6 =	220 Ω
	7 =	0 Ω

B17

Spark-advance angle without vacuum
Engine at norm. op. temp., but < 95°C
Air-intake temperature--sensor plug disconnected.

* 18...20° before TDC
at 3200 min^{-1}

C7

* Is adjusted at trimming plug.
To avoid incorrect adjustment, always test in accordance with instructions from the coordinates.

C11

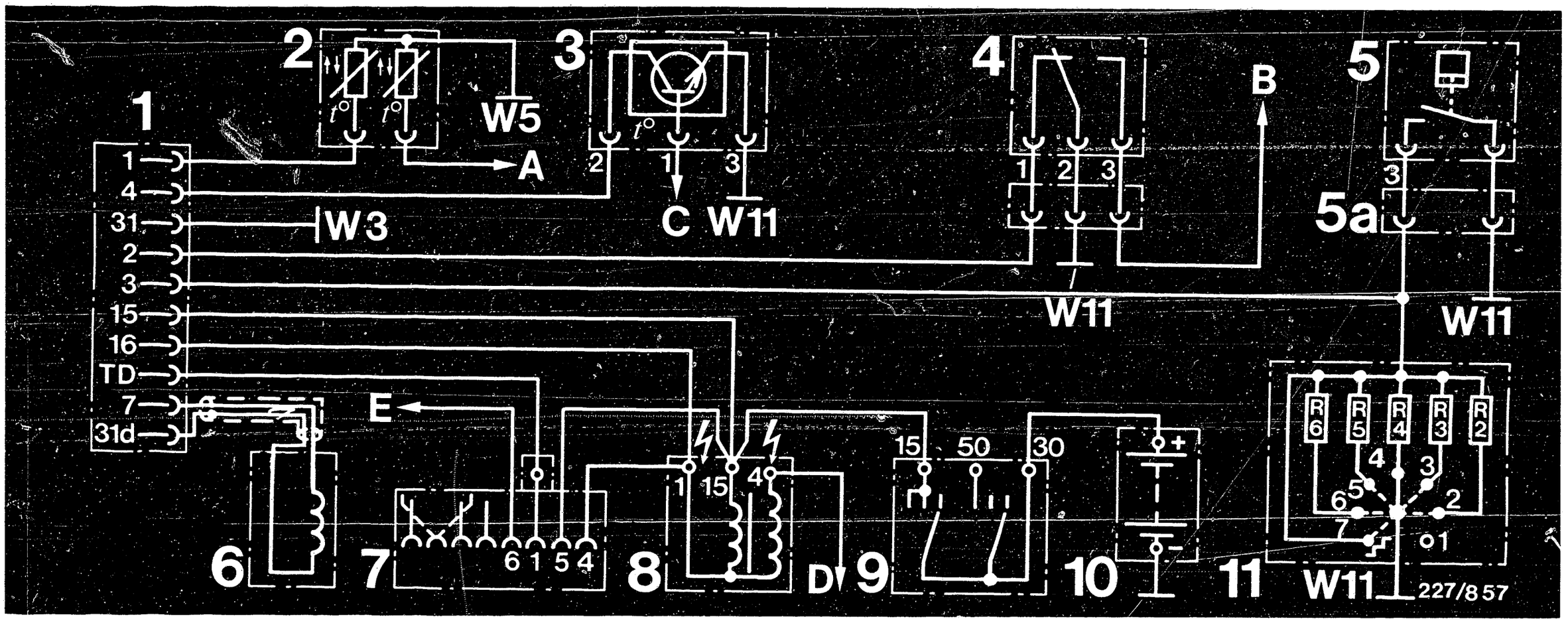
Air-intake temperature sensor	> + 25°C	0 V
	< + 25°C	approx. batt. +ve

C13

Throttle-valve-switch
idle contact
Idle position — approx. 0 Ω
Throttle valve open — ∞Ω

Voltage supply, EI control unit and ignition coil with engine at idle	12 ... 14 V max. 1 V below batt. +ve	C15
Peak-coil-current cutoff approx. 1 s after ignition "ON"	0 V	C17
Primary voltage with engine at idle	280 ... 360 V	C19
Insulation, pulse generator	$\infty\Omega$	C21
Internal resistance, pulse generator	680 ... 1200 Ω	
Voltage, pulse generator at cranking speed	U_S > 1 V	C23
Voltage, EI control unit with ignition "ON"	batt. +ve	D1
Voltage, primary circuit with ignition "ON"	batt. +ve	

See Autodata test specifications for the settings for idle speed, exhaust gas, valve clearance etc.



Danger arrows:
Warning: 400 V ... 25 kV

1 = EZ control unit
2 = Coolant-temperature sensor (double NTC)
3 = Intake-air temperature sensor (with switching electronics + 25°C)
4 = Throttle-valve switch
5 = Transmission overload-protection switch (automatic transmissions only)
5a= Transmission overload-protection switch plug connector
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition/starting switch
10 = Battery
11 = Adjustment plug

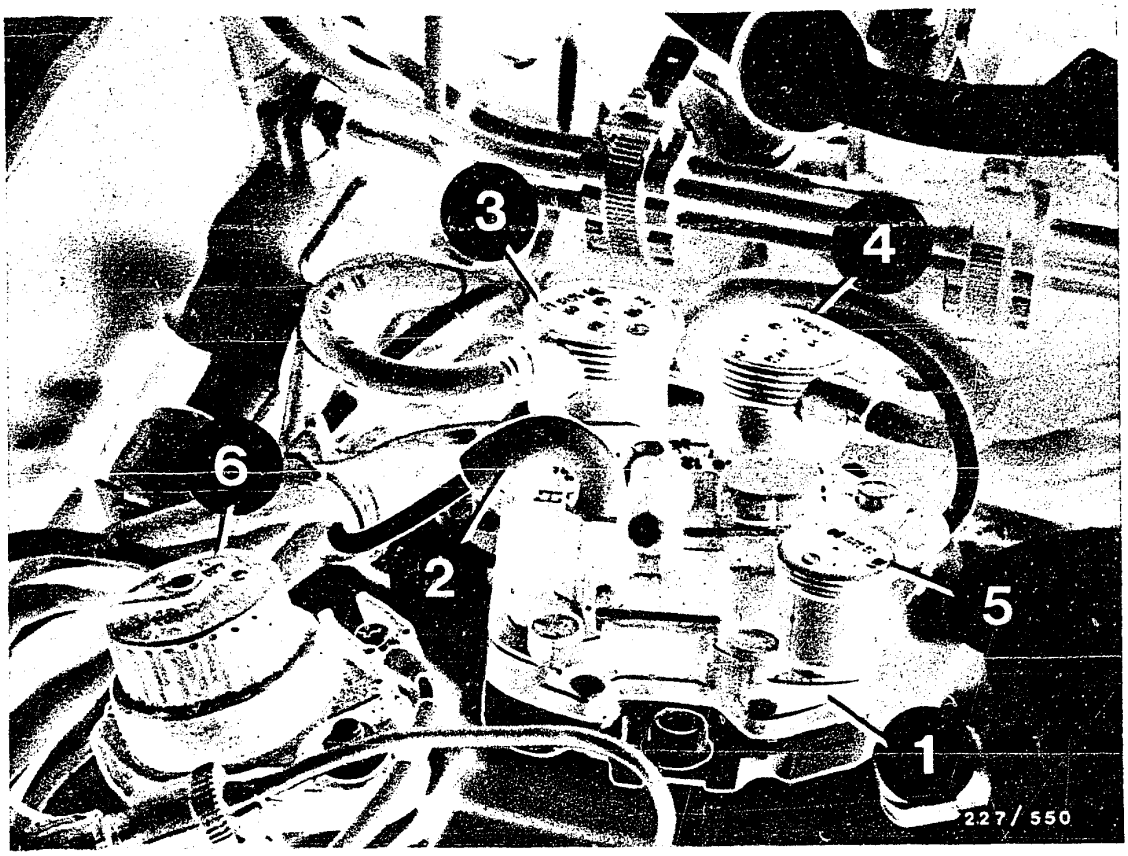
A = to KE-Jetronic control unit
B = to KE-Jetronic control unit
C = to electromagnetic clutch, engine cooling fan
D = to high-voltage distributor
E = to central-electrics box connector S no. 13 (term. 30)

W3 = Ground, wheel housing, left of ignition coil
W5 = Ground, engine
W11= Ground, engine (with engine cooling fan operating)

3. Electrical terminal diagram

A5 | Electrical terminal diagram | Mercedes-Benz | →

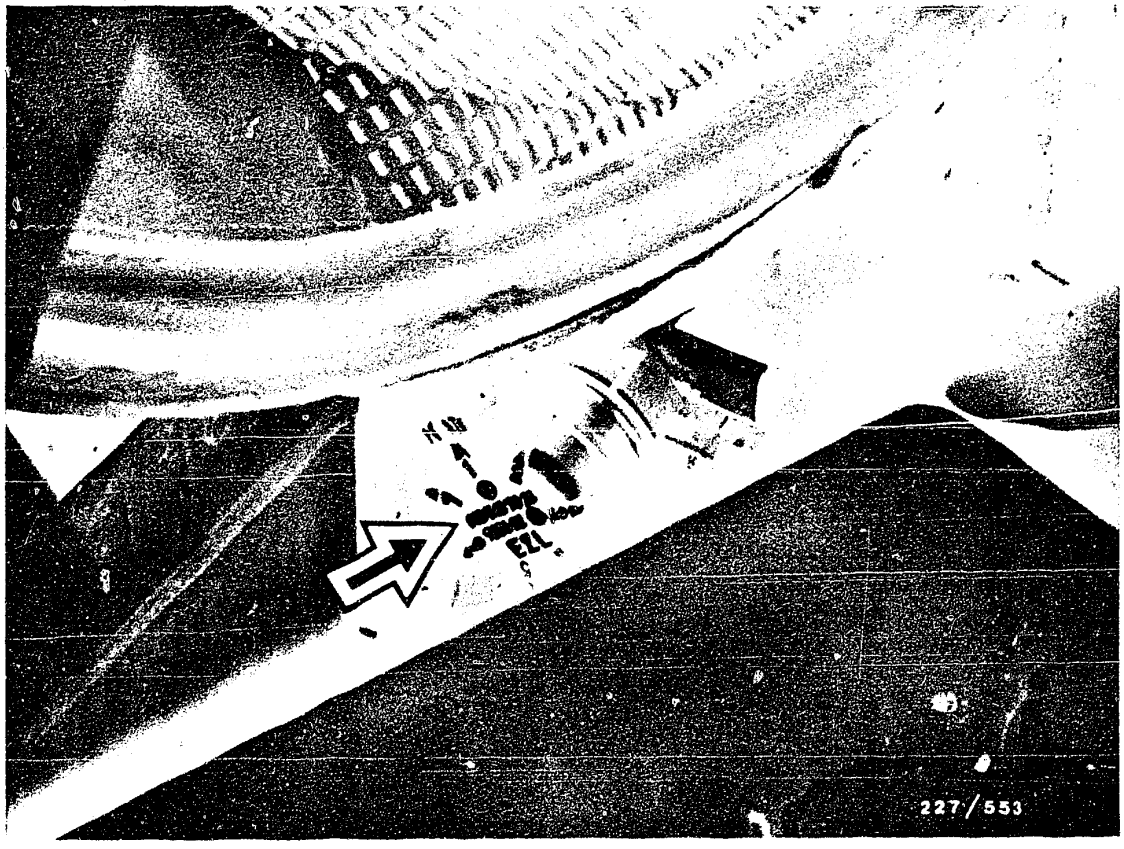
A6 | Electrical terminal diagram | Mercedes-Benz | ←



1 = Electronic ignition control unit
2 = Vacuum hose
3 = Quadruple plug - power supply
4 = Quadruple plug - sensor
5 = Coaxial plug - pulse generator
6 = Diagnosis socket

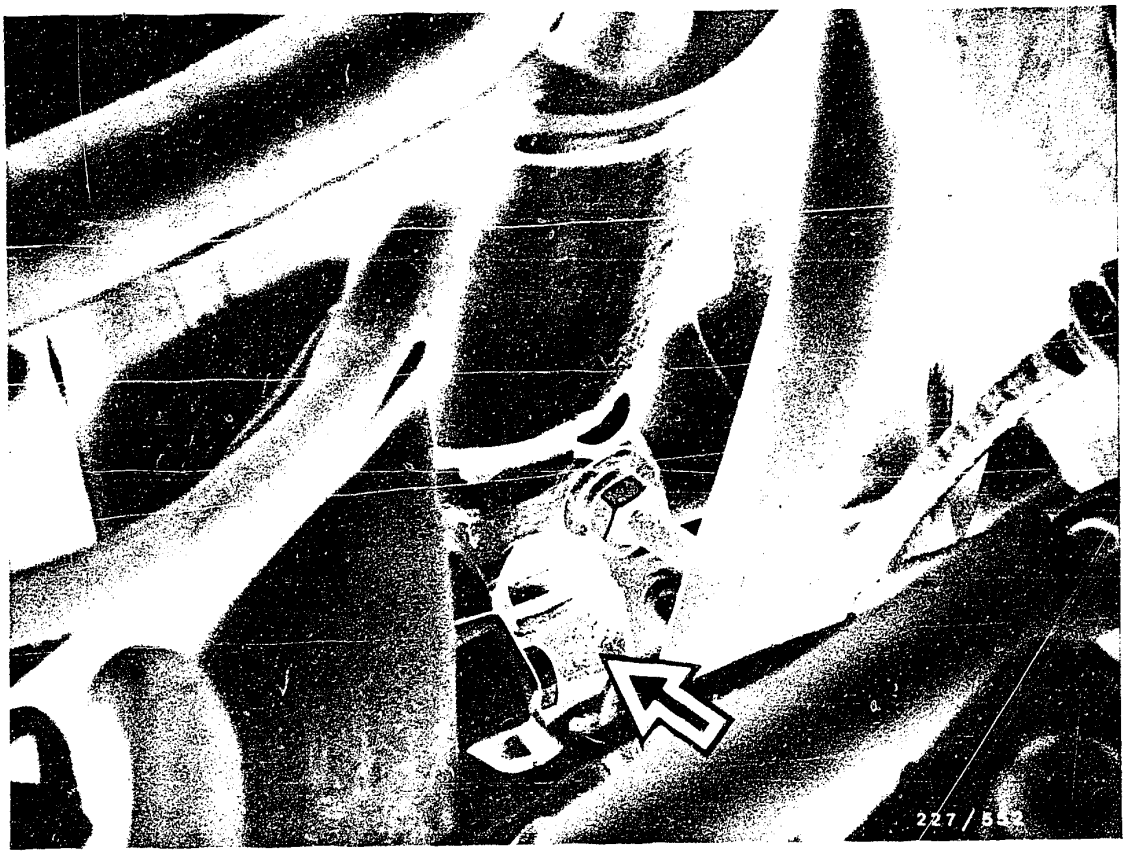
4. Installation position of components

EZ control unit and diagnostic socket are on the wheel housing on the left-hand side as viewed in the forward direction of travel.



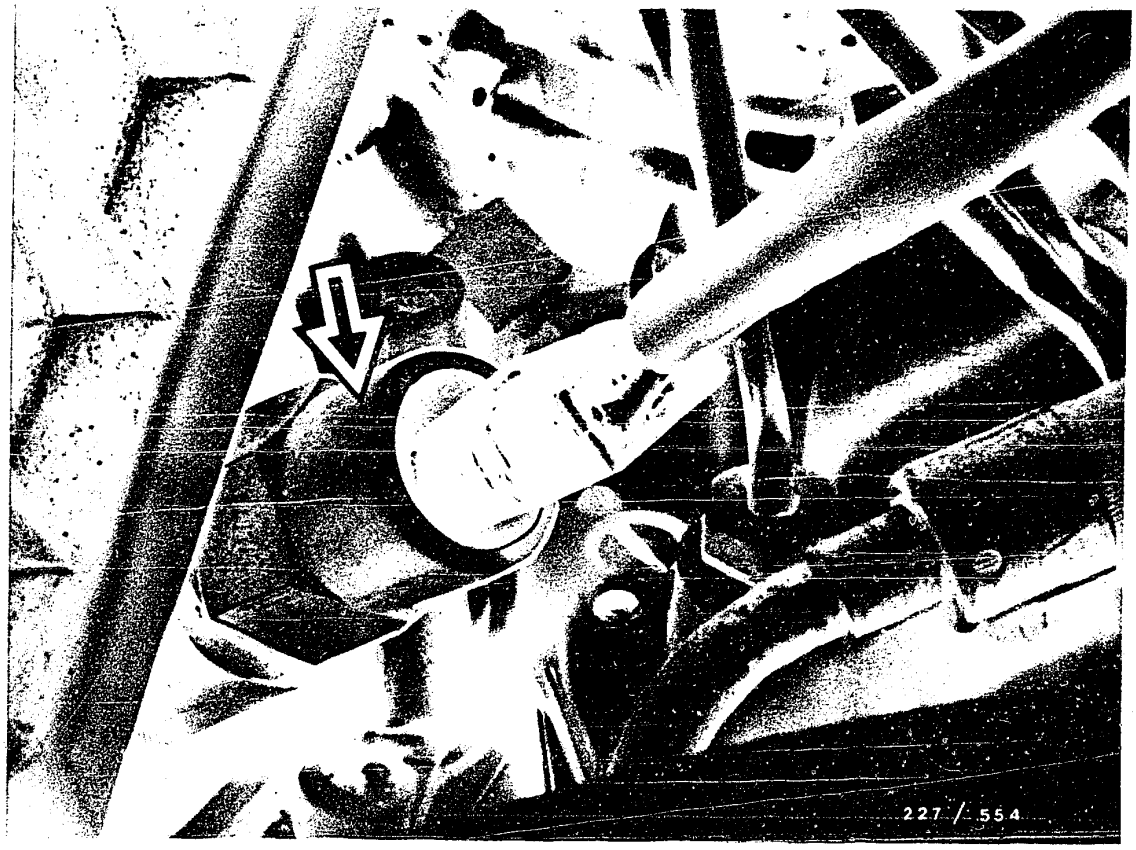
Arrow = Trimming plug, ignition

The trimming plug is located behind the battery.



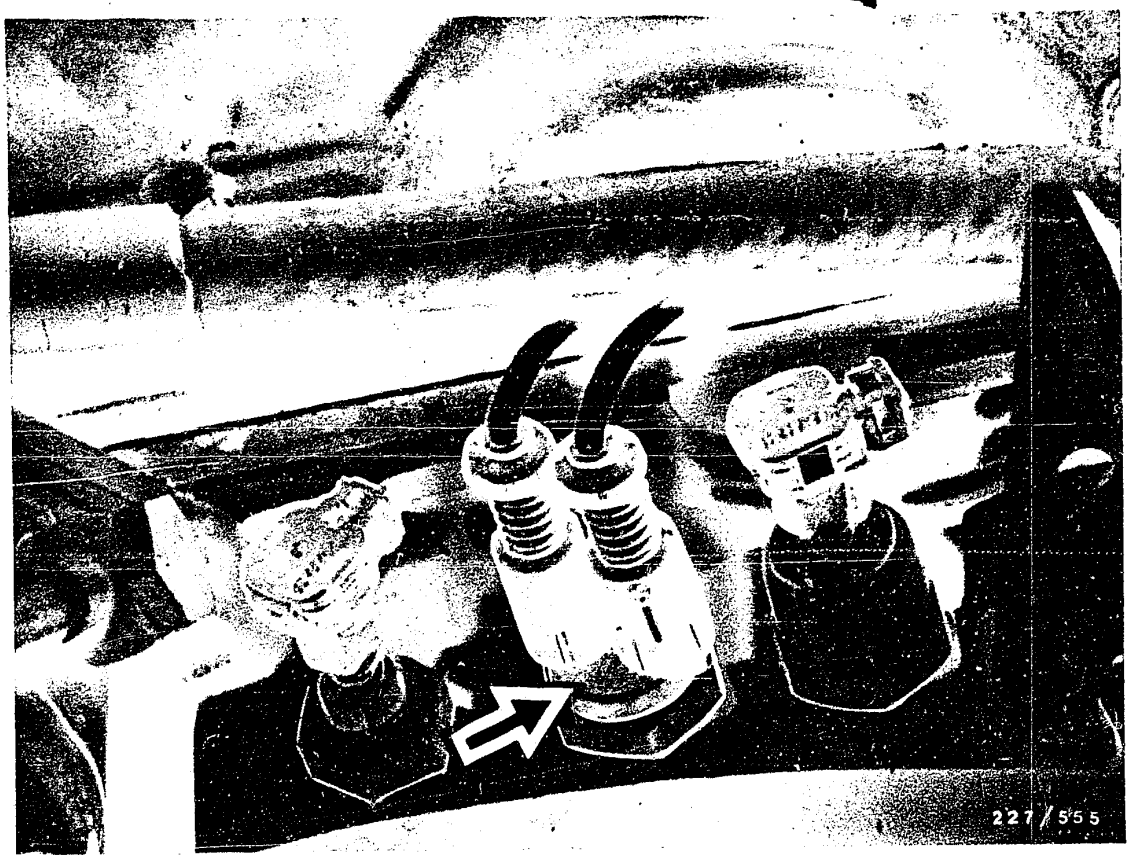
Arrow = Pulse generator

The pulse generator is located on the engine block on the left, looking in the direction of forward vehicle travel (below the oil filter).



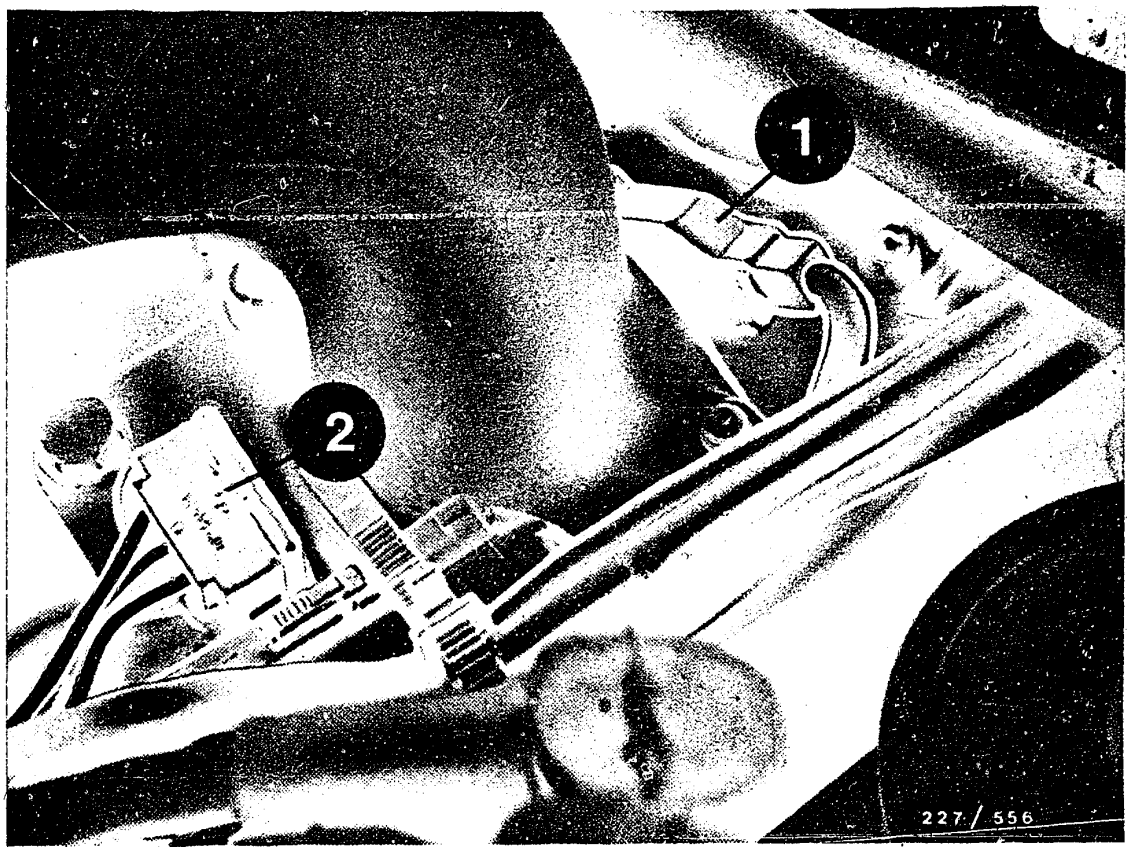
Arrow = Intake air temperature sensor with electronic switch + 25°C

The intake air temperature sensor is located on the air filter.



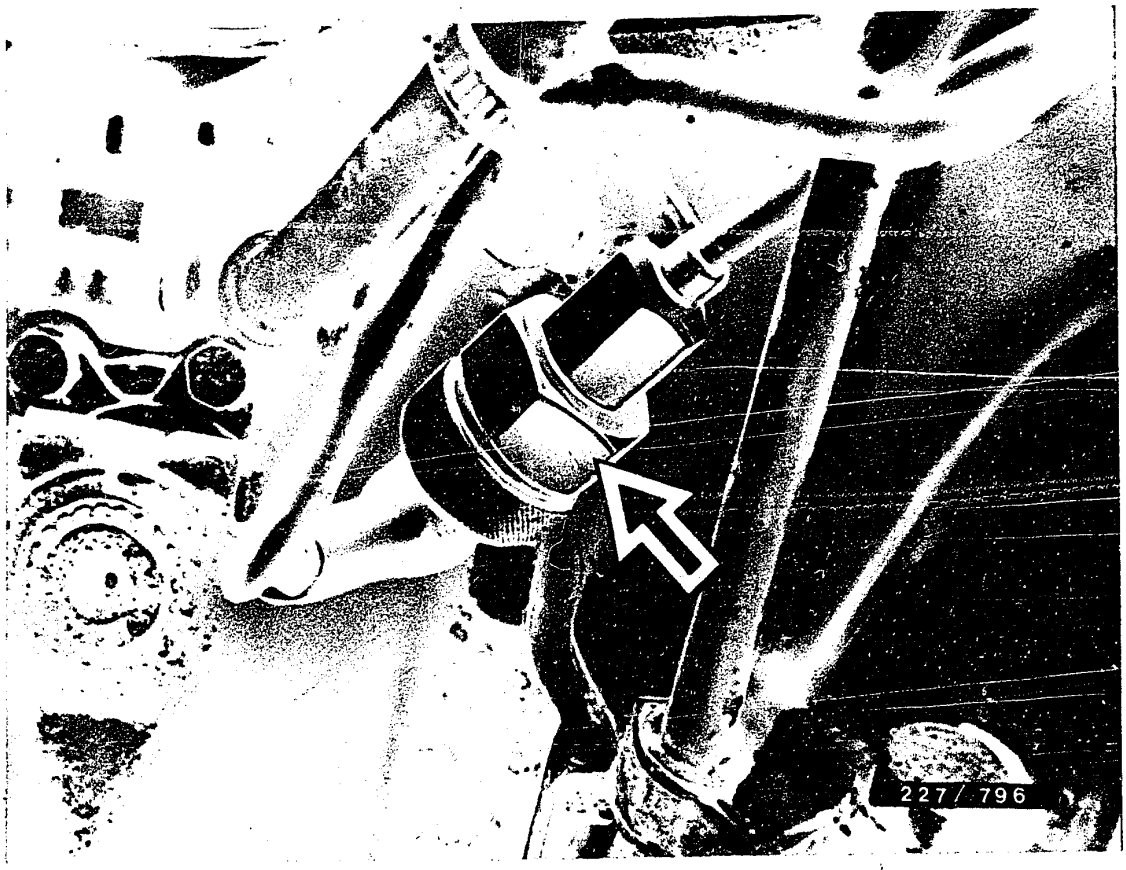
Arrow = Coolant temperature sensor (double NTC)

The coolant temperature sensor is located at the front on the cylinder head (thermostat housing).



1 = Throttle-valve switch
2 = Plug connection from the throttle valve switch

The throttle-valve switch is located on the throttle-valve assembly.



Arrow = Transmission overload-protection switch
(automatic transmissions only)

5. Necessary test equipment and auxiliaries

Motortester e.g.	MOT 201	0 684 000 201
Pulse shaper (is required for measuring the primary voltage with MOT 201, 202, 206 and 400)		1 684 463 154
Adapter lead for diagnostic socket		1 684 463 094
Spark gap e.g. ignition-coil/ condenser tester	EFAW 106 A	0 681 100 001
or single spark gap	EF 1177/7	1 684 531 000
5 kΩ sleeve-type suppressor		0 356 500 001
Ohmmeter	ETE 014.00	0 684 101 400
or e.g.	Pontavi Wh 2	commercially available
Voltmeter e.g.	ETE 014.00	0 684 101 400
Thermal-conduction paste		5 942 860 003
Test prod, black		1 684 485 034
Test prod, red (for correct connection of test equipment at connectors)		1 684 485 035
Refrigerant spray	Testing of intake-air temperature sensor	commercially available
Hairdryer or		commercially available
solder gun		

6. Danger of accident on electronic ignition systems

Increased demands of modern engines on the ignition system combined with the desire for freedom of maintenance have recently led to electronic ignition systems being fitted as standard. Usually the ignition power of electronic systems (of almost all manufacturers) is higher than that of conventional systems, and there are signs of further increases in power. Electronic ignition systems thus reach a power range which can be highly dangerous if live parts of terminals are touched (both on the primary as well as the secondary sides).

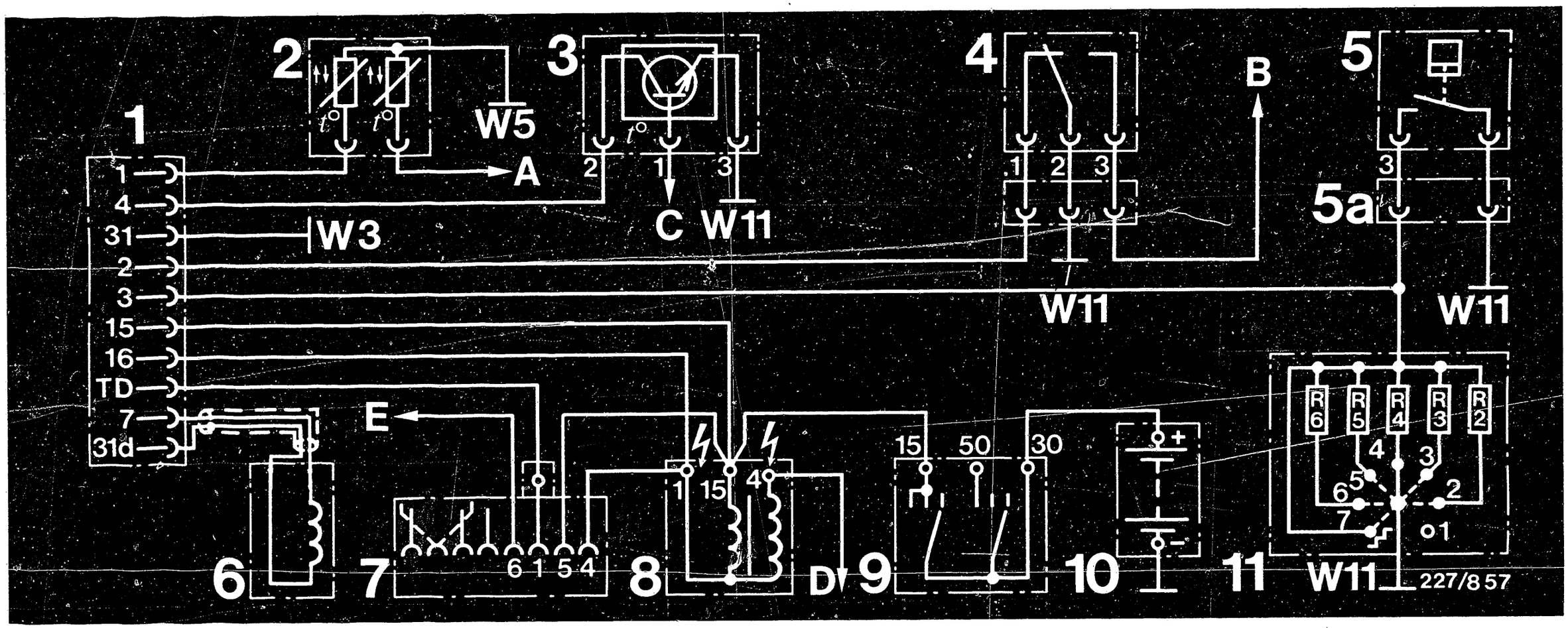
In this connection we should like to point out that the VDE regulations, in particular VDE 0104/7.67 and/or the respective national regulations must be followed when testing or working on the ignition system.

The ignition should always be switched off when working on the ignition system (switch off ignition or voltage source). Such work includes:

- Connecting of engine test equipment (timing light, dwell-tach tester, ignition oscilloscope etc.).
- Replacing parts of the ignition system (spark plug, ignition coil, ignition distributor, ignition cable etc.).

If, while testing the ignition system or during adjustment work on the engine (e.g. KE-Jetronic), it becomes necessary to switch on the ignition (switch on ignition or voltage source), the above-mentioned dangerous voltages occur over the entire system.

The danger of accident exists, therefore, not only on the individual assemblies of the ignition system (e. g. ignition distributor, ignition coil, trigger box, ignition harness), but also on the wiring harness (e. g. tachometer connection, diagnostic plug), at plug-in connections and test equipment.



Danger arrows:
Warning, 400 V ... 25 kV

1 = EZ control unit
2 = Coolant-temperature sensor (double NTC)
3 = Intake-air temperature sensor (with switching electronics + 25°C)
4 = Throttle-valve switch
5 = Transmission overload-protection switch (automatic transmissions only)
5a = Transmission overload-switch plug connector
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition/starting switch
10 = Battery
11 = Adjustment plug

A = to KE-Jetronic control unit
B = to KE-Jetronic control unit
C = to electromagnetic clutch, engine cooling fan
D = to high-voltage distributor
E = to central-electrics box connector S no. 13 (term. 30)

W3 = Ground, wheel housing, left of ignition coil
W5 = Ground, engine
W11 = Ground, engine (with engine cooling fan operating)

Electrical terminal diagram
The dangerous locations are marked with high-voltage symbols taking the example of the terminal diagram of an electronic ignition system.

7. Incorrect indication of engine speed, dwell angle and ignition point

In the case of ignition systems with control unit 0 227 400 5.. or control units from Siemens (electronic ignition) with current limitation, there can be an incorrect reading for engine speed, dwell angle, and ignition timing on the test instruments.

For further details see coordinates N 7 - N 11.

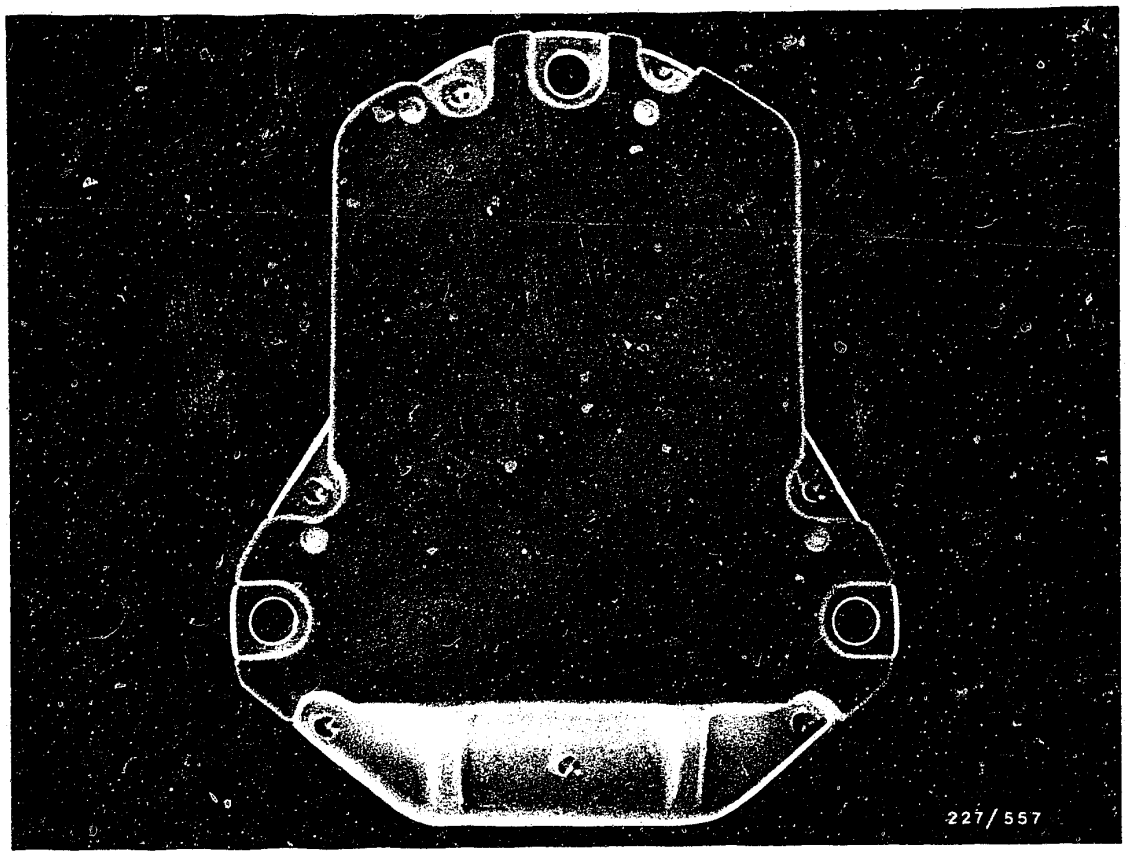
8. Important vehicle information

- Resistance measurements must only be performed with the ignition switched off or with the battery disconnected (measuring instrument defective).
- For a compression test, disconnect the coaxial plug (pulse generator) from the electronic ignition control unit.
- Never disconnect the battery while the engine is running.
- A starting assist with more 16 Volts or with a quick-charger is not permitted.
- The specified ignition coil (see Part.No.) must not be replaced with a different ignition coil.
- No suppression capacitor must be connected to ignition coil terminal 1.
- Ignition coil terminal 1 must not be brought into contact with ground as a theft-proofing measure (ignition coil will be destroyed when ignition is switched on).
- No battery + or test lamp must be connected to ignition coil terminal 1 (the electronic ignition control unit is destroyed).
- The ignition lead from the ignition coil Term. 4 to the high voltage distributor Term. 4 must not be disconnected during operation.
- There must be no arcing from ignition coil terminal 4 to ignition coil terminal 1 and 15.
 The electronic ignition control unit can be destroyed.

- If the poles are reversed on the ignition coil (Term. 1 and Term. 15) there are severe losses of ignition energy, causing missing. In addition, the electronic ignition control unit is overloaded. In order to preclude reversal of poles, the terminal studs have different diameters. (M5 and M6)

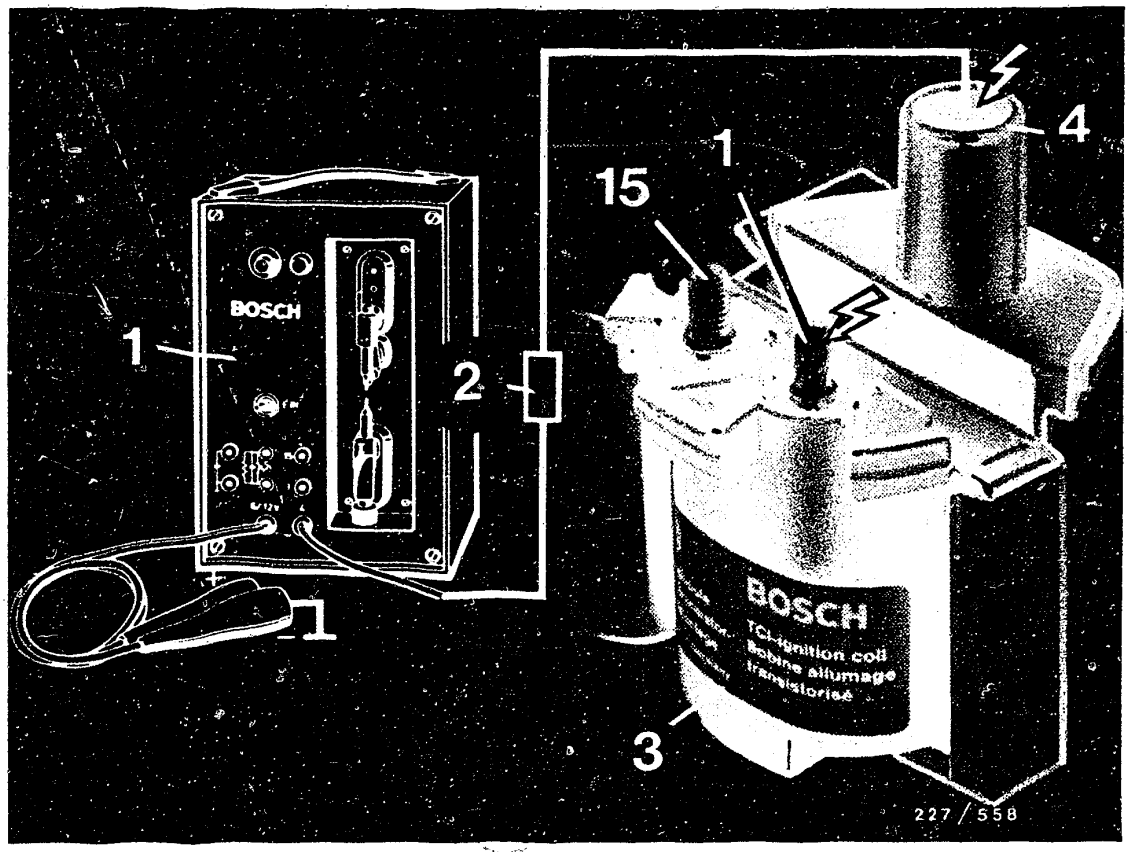
- In order to avoid destruction of the electronic ignition control unit, the secondary end of the ignition system must have interference suppression of min. 2 k Ω. The original distributor rotor must be installed with an interference suppression resistor of 1 k Ω. (Do not use a 5 k Ω distributor rotor for radio and interference suppression either.)

- If the poles on the battery are incorrectly connected, the electronic ignition control unit and the ignition coil are destroyed.



- Before putting on the electronic ignition control unit, the base plate (see the Figure, bright surface) must be coated with a heat conduction paste.
 Before mounting the trigger box, the base plate must be coated with thermal conduction paste. Apply thermal conduction paste only with a suitable object (screwdriver, etc.).

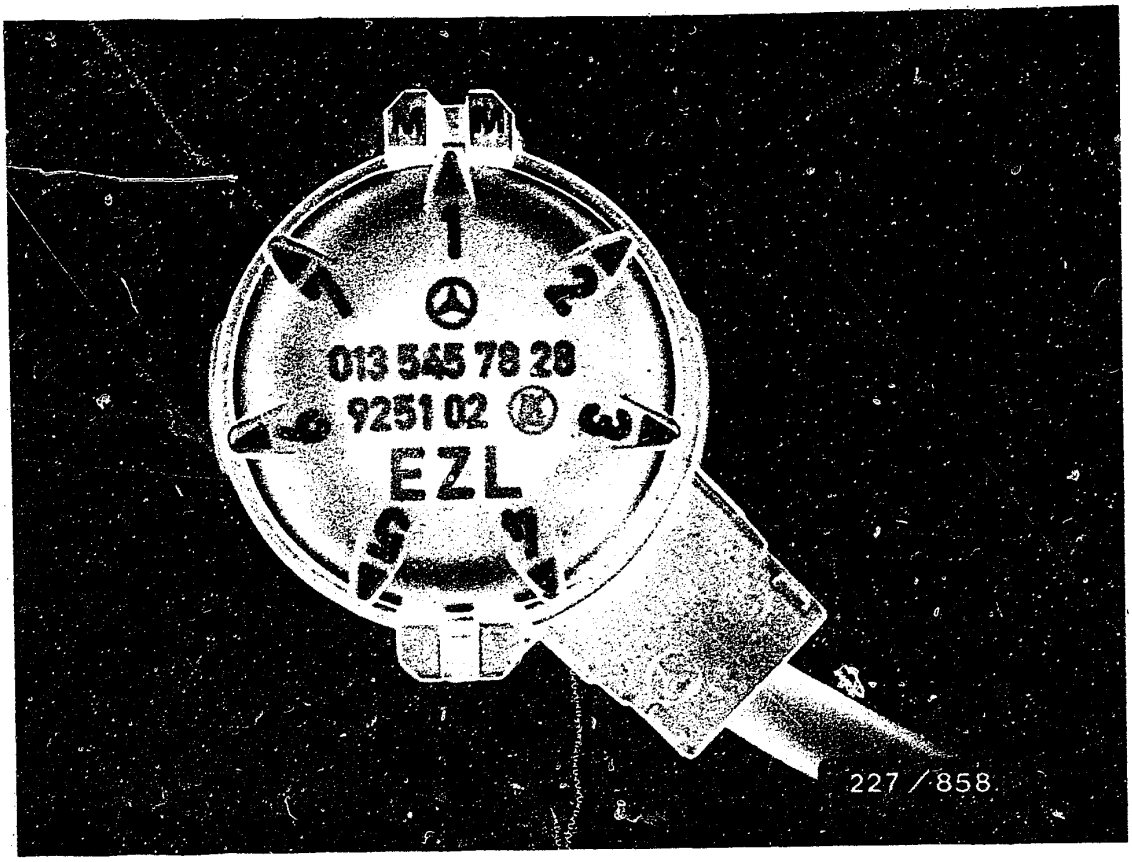
 Do not apply thermal conduction paste to painted parts.



High voltage arrows:
Warning, 400 V ... 25 kV

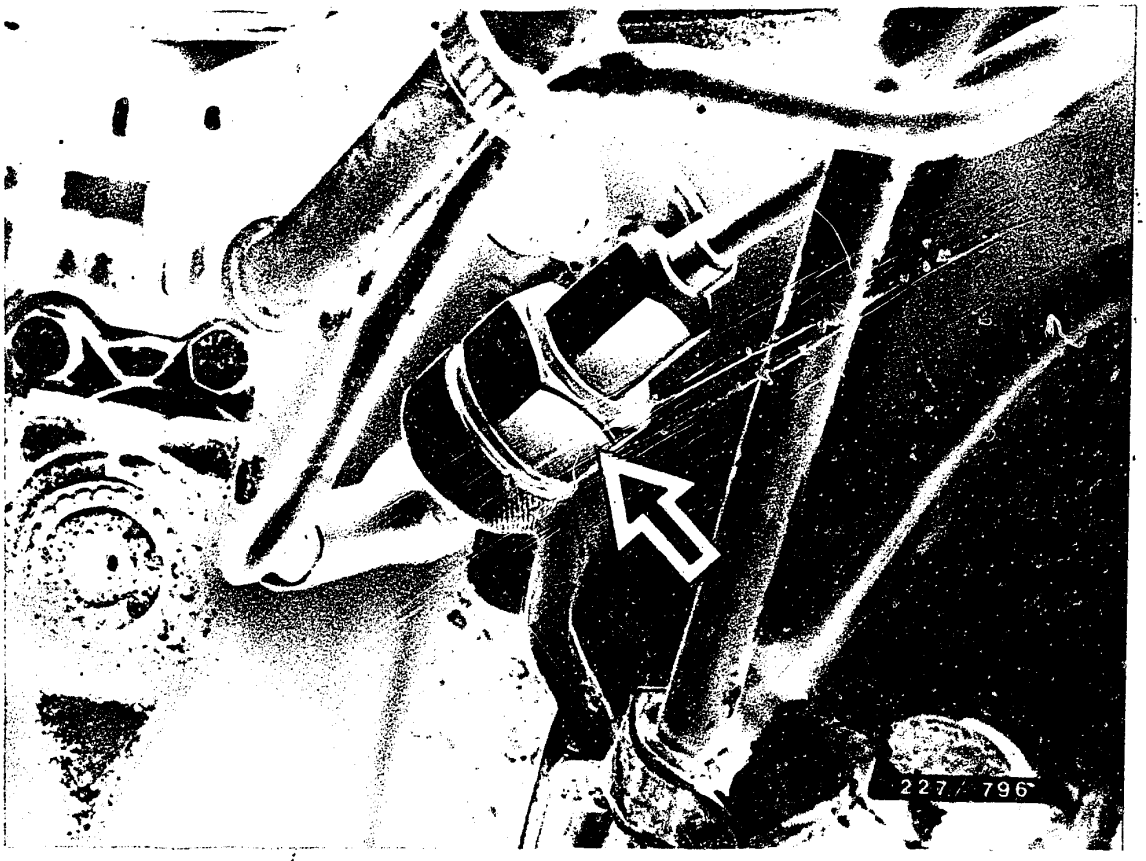
1 = Spark gap
2 = 5 kΩ sleeve-type suppressor
3 = Ignition coil

- In order to prevent the trigger box from being irreparably damaged, when using a spark gap, an interference-suppression resistor of at least 2 kΩ must be connected between the spark gap and ignition coil terminal 4, e. g. sleeve-type suppressor (5 kΩ) 0 356 500 001.



Trimming plug

- If premium fuel with a lower octane rating is used, the engine may ping. In order to avoid any possible damage to the engine, the spark-advance angles may be retarded by means of the trimming plug.
 Procedure: Disconnect the trimming plug, adjust and reconnect. See illustration. Each position of the trimming plug corresponds to retardation of the spark-advance angle by approx. 2° at the crankshaft. If fuel of the specified octane rating then becomes available, adjust the spark-advance angle in accordance with coordinates B17...C7.
 Note with respect to automatic transmission:
 Trimming-plug position "7" must not be used, since this signal is used for the transmission-overload protection function.



Arrow = Transmission-overload-protection switch
(automatic transmission only)

In order to prevent the brake bands of the transmission from being overloaded when shifting up gear, the ignition point is retarded to TDC for a brief moment (0.4 s) by the EI control unit . Control/triggering is by means of the transmission overload-protection switch. See picture, arrow.

Note: If the transmission overload-protection feature is defective, the EZ control unit operates in limp-home mode.

9. Trouble-shooting

9.1 How to use the trouble-shooting chart

The trouble-shooting chart starting on Coordinate B 3 contains customer complaint (fault symptom), cause of trouble, test instructions and coordinate references.

The possible cause of the fault should be selected from the trouble-shooting chart in accordance with the customer complaint (fault symptom).

If the cause of the fault is not clear, start testing with the detailed, self-contained trouble-shooting program beginning on Coordinate B 9.

If the cause of the fault is clear from the trouble-shooting chart, direct trouble-shooting is possible by going to the stated coordinate without having to perform the entire trouble-shooting program for each fault.
If there is no coordinate reference, trouble-shooting must be performed in accordance with the "Test instructions" column.

9.2 Procedure - trouble-shooting program

The trouble-shooting program starting on Coordinate B 9 is divided into 3 rows of boxes.

The left-hand row contains test instructions and test specifications.

The center row contains repair instructions.

The right-hand row contains the illustrations/terminal diagrams belonging to the text and the explanations of the items in the picture.

If the questions asked in the left-hand row can be answered conclusively with "yes", then proceed to the next test down.

If the answer to the question is "no", branch to the center row and carry out the tests given there.

9.3 Before testing, make sure of the following:

Battery fully charged, fuel system O.K., engine mechanically O.K. (e. g. compression, valve clearance etc.). Ambient temperature/ignition system temperature 0^{o} to 100^{o} C (temperature has a considerable effect on measured values).

9.4 Trouble-shooting chart

Customer complaint (fault symptom)

1. Starting motor operates, but engine fails to start
2. Rough idling
3. Poor throttle response
4. Engine lacks power
5. Misfiring
6. Fuel consumption too high
7. Engine pings when accelerating
8. Backfiring
9. Engine becomes too hot

1	2	3	4	5	6	7	8	9	Cause of fault	Test instructions	Coordinate
●	●	●	●	●	●	●	●	●	Unclear	Perform detailed trouble-shooting	B 9
●	●	●	●	●	●	●	●		Spark plugs defective	Assessment by means of ignition oscilloscope or visual examination of spark plug when removed	----
●	●	●	●						Shunt on secondary side	Evaluation of the ignition coil, high voltage distributor, ignition harness, and spark plug by means of the ignition oscillogram or a visual inspection	----
●	●	●	●						Open circuit on secondary side	Assessment of ignition coil, ignition distributor, ignition harness and spark plug by means of ignition oscilloscope, or continuity test with ohmmeter	----
●	●	●	●						Ignition coil defective	-	B 11
		●	●	●	●				Interference-suppression resistors defective	Assessment by means of ignition oscilloscope or resistance measurement	----

Trouble-shooting chart (continued)
Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start	2. Rough idle	3. Poor throttle take-up (flat spot on acceleration)	4. Insufficient engine power	5. Misfiring	6. Fuel consumption too high	7. Engine pinging when accelerating	8. Backfiring	9. Engine overheating	Cause of trouble	Test instructions	Coordinates
•							•		Firing sequence incorrect	1 - 3 - 4 - 2	-----
•		•		•			•		High-voltage distributor setting incorrect	---	B 13
•									Contact resistance, ignition coil or EI control unit not O.K.	---	B 15
				•					Vehicles with automatic transmission only Transmission overload protection defective Note: Defective transmission-overload protection may become noticeable through misfiring.	---	B 17...B 19
			•		•	•		•	Pressure sensor defective	---	B 21
			•		•				Coolant-temperature sensor defective	---	B 23
			•		•	•			Spark advance incorrect	To avoid incorrect measurements, be sure to perform testing as given on coordinates.	B 17...C 7
						•			Intake-air temperature sensor defective	---	C 11
			•		•	•		•	Throttle-valve switch (idle contact) defective	---	C 13

Trouble-shooting chart (continued)

Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start	2. Rough idle	3. Poor throttle take-up (flat spot on acceleration)	4. Insufficient engine power	5. Misfiring	6. Fuel consumption too high	7. Engine pinging when accelerating	8. Backfiring	9. Engine overheating	Cause of trouble	Test instructions	Coordinates
				•					EZ control unit/ignition coil power supply defective (engine idling)	---	C 15
•									Peak-coil-current cutoff (EZ control unit) defective	---	C 17
				•					Primary voltage (EZ control unit) incorrect	---	C 19
•									Pulse-generator insulation, internal resistance, voltage incorrect	---	C21...C23
•									EZ control unit power supply incorrect (ignition ON)	---	D 1
•									Primary-circuit power supply incorrect (ignition ON)	---	D 1

9.5 Detailed trouble-shooting program

Test primary signal. If no oscilloscope or tachometer available, check whether ignition spark across spark gab.
Remove the protective cap from the ignition coil.

Primary signal testing with oscilloscope
Connect oscilloscope to ignition coil as per operating instructions.
Start engine.
Oscilloscope must indicate a primary voltage (of any value).

Primary signal testing with tachometer
Connect tachometer to ignition coil as per operating instructions.
Start engine.
Tachometer must indicate a reading (of any value)

Primary signal testing with tachometer
Connect tachometer to ignition coil as per operating instructions.
Start engine.
Tachometer must indicate a reading (of any value).

Ignition spark testing with spark gap
Remove H.T. ignition cable terminal 4 from ignition coil. Connect spark gap including sleeve-type suppressor (5 kΩ) to ignition coil. Adjust spark gap to 5 mm.
Start engine.
There must be sparks across the spark gap.
Primary signal present or ignition sparks across spark gap?

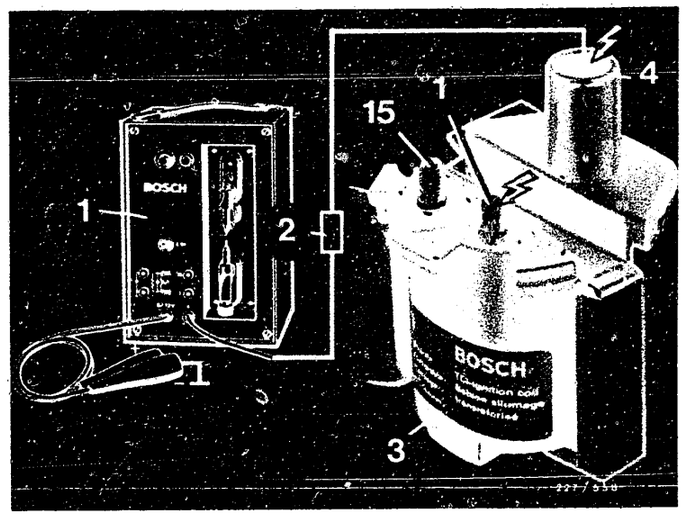
no →

If no primary signal or no ignition spark, continue testing at C21.

Tests from B 11 onwards not necessery.

yes ↓

Continued on B11/B12



High voltage arrows:
Warning, 400 V ... 25 kV!

1 = Spark gap
2 = 5 kΩ sleeve-type suppressor
3 = ignition coil

Check distributor cap, distributor rotor, H.T. ignition cables and spark plugs.

High-tension side O.K.?

no → Repair haigh-tension side.

yes

Check the ignition coil.

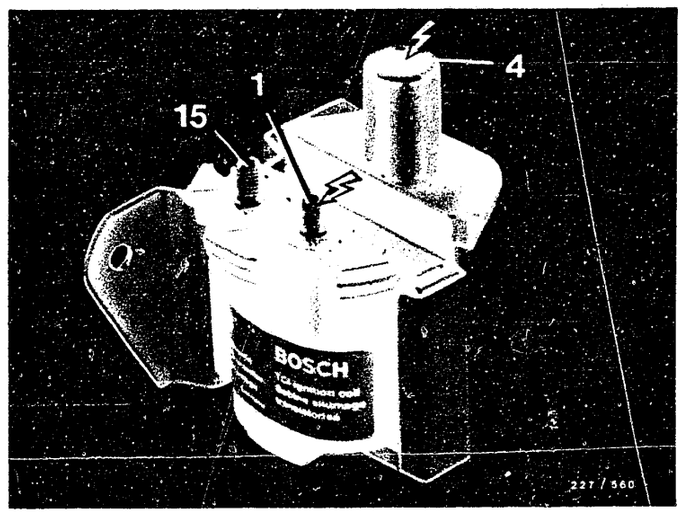
Remove the protective cap from the ignition coil.
Primary ignition coil (Term. 15 and 1) 0.30...0.60Ω (Take resistance of measuring lead and test prods into consideration.)
Secondary ignition coil (Term. 1 and 4) 7.3...13.2 kΩ.

Are values for resistance O.K.?

no → Replace ignition coil.

yes

Continued on B13/B14



High voltage arrows:
Warning, 400 V ... 25 kV

Engine running?

no

yes

1st test step

Remove the cap and the dust protector cover from the high voltage distributor.

Set Cylinder 1 at the TDC marking. For the marking, see the Figure at the top.

The distributor rotor must be positioned such that the center of the distributor rotor electrode points toward the mark on the housing for cylinder 1.
See arrows in bottom picture.

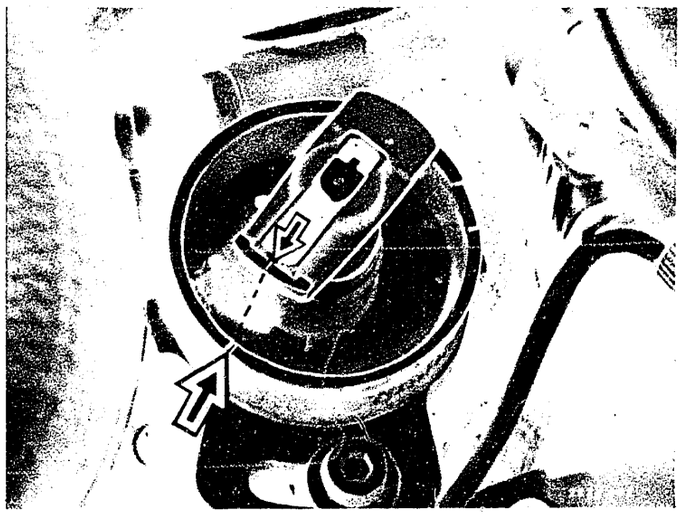
Adjust the high voltage distributor.



Arrow=TDC marking

Continued on B17/B18

Continued on B15/B16



continued

2nd test step

Disconnect the negative and positive leads from the battery.

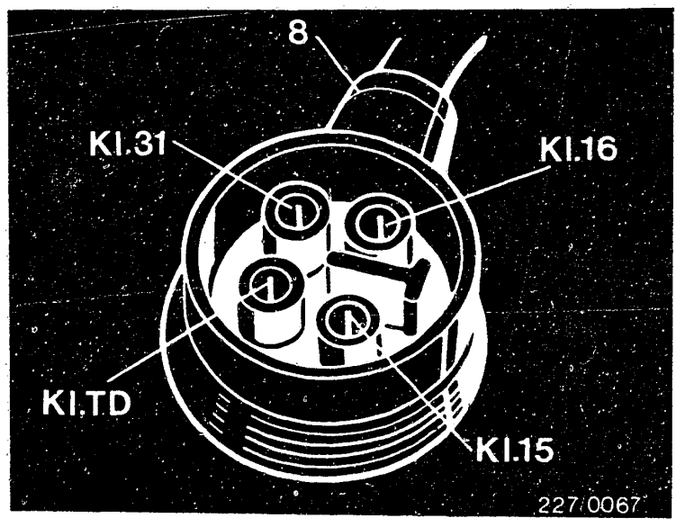
Disconnect the electronic ignition control unit plug. Switch the ignition on.

1. Check the leads from the positive battery terminal to the electronic ignition control unit plug Term. 15 and the leads from the negative battery terminal to the electronic ignition control unit plug Term. 31 for contact resistances. Max. total contact resistance 0.3Ω. (Take resistance of measuring lead into consideration.) Eliminate contact resistances.

2. Check the leads from the positive battery terminal to the ignition coil Term. 15 and the lead from the ignition coil Term. 1 to the electronic ignition control unit plug Term. 16 for contact resistance. Max. total contact resistance 0.3 Ω. (Take the resistance of the measuring lead into consideration.) Eliminate any contact resistance.

3. If test steps 1 and 2 were O.K., try installing a new specified ignition coil. If engine still not running, re-install "old" ignition coil and replace EZ control unit.

yes



8=Electronic ignition control unit plug
Kl.=Term.

Continued on B17/B18

<u>Check transmission overload protection.</u>
Vehicles with automatic transmission only.
1. Loosen union nut on transmission overload-protection switch and disconnect connector.
See arrow in top picture.
Connect ohmmeter to transmission overload-protection switch. See bottom picture.
Operate engine at idle.

<u>Attention:</u>
Observe safety regulations for the following test (e.g. pull on hand brake, position chocks at rear wheels).

See table for resistance values for respective selector-lever position:

<u>Driving position</u>	<u>Resistance</u>
"N" or "P"	= > 20 kΩ
"D"	= < 1 Ω

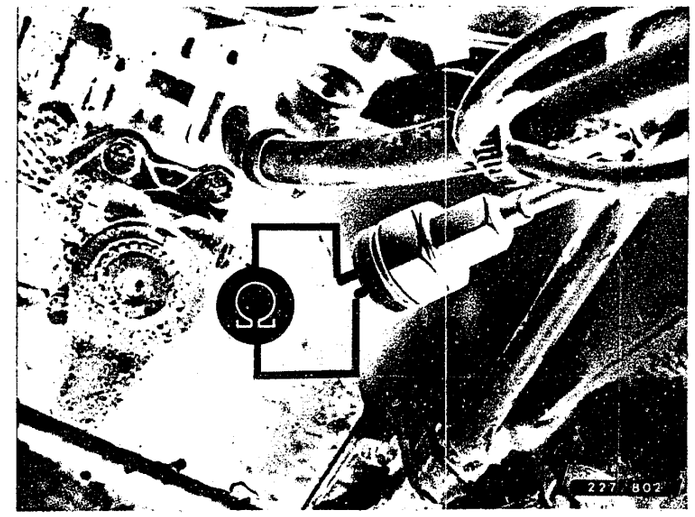
Resistance values O.K.?

no → Replace transmission overload-protection switch. Repeat test. If resistance values still not obtained, repair transmission (DB dealer).



yes

Continued on B19/B20



Continued

2. Read off adjustment-plug position and note down.
Pull out adjustment plug as far as it will go, bring into position "1" and plug on again. See top picture.

Switch off ignition.
EZ control-unit plugs connected.
Connect voltmeter to disconnected connector of transmission overload-protection plug.
See bottom picture.
Switch on ignition.
Voltmeter must indicate approx. 5 V.
Voltage correct?

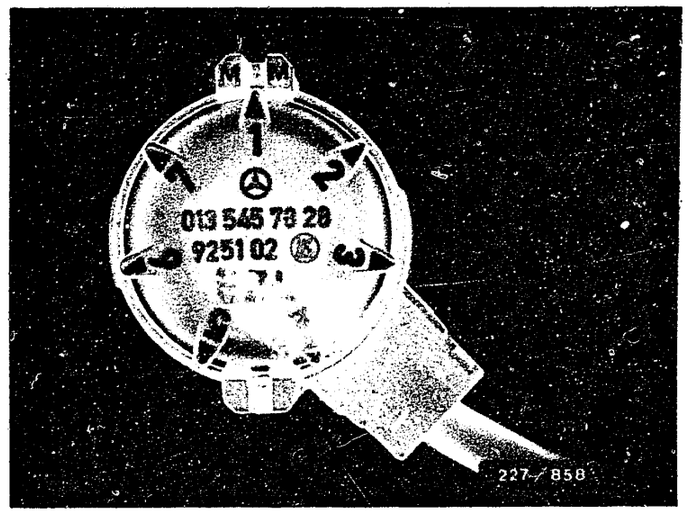
no → Check for open circuit on positive and negative sides.
Eliminate open circuit.
If there was no open circuit, replace EZ control unit.

yes

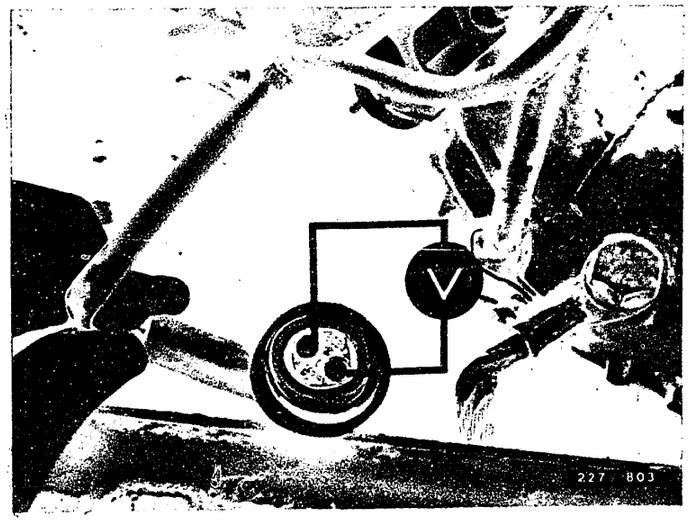
Re-establish original position of adjustment plug.

yes

Continued on B21/B22



Adjustment plug position "1"



Check the pressure sensor
Connect the motortester to the diagnosis socket using an adapter cable. Disconnect the vacuum hose from the electronic ignition control unit. See the Figure at the top.

Take the plug connection from the throttle valve switch apart. See the Figure at the bottom. Run the engine at idle.

Take reading for timing angle.

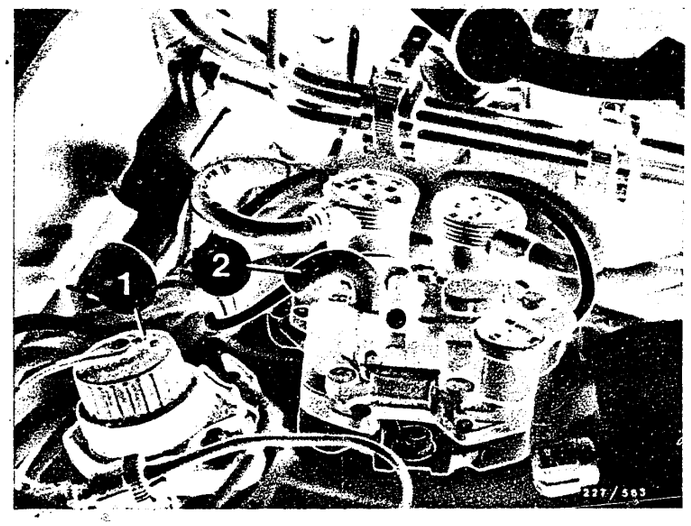
Put the vacuum hose back on the electronic ignition control unit. When this is done, the timing angle must change noticeably (in the direction "advance").

Did the timing angle change?

no

1. Check the vacuum hose from the electronic ignition control unit to the intake manifold plug connection for leaks. Eliminate any leaks.

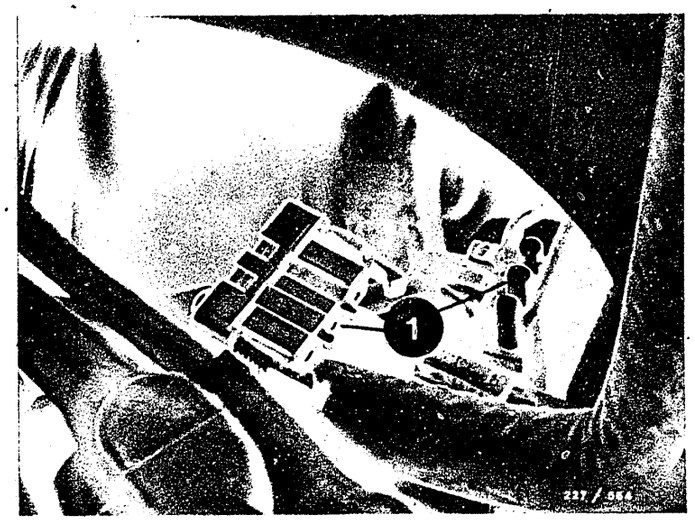
2. If there was no leak, take out and replace the electronic ignition control unit.



1=Diagnosis socket
2=Vacuum hose

yes

Continued on B23/B24



1=Plug connection from the throttle valve switch

Check the coolant temperature sensor.

Warm the engine up to normal operating temperature.
Connect the motortester to the diagnosis socket using an adapter lead.
Disconnect the vacuum hose at the electronic ignition control unit.
Disconnect the intake air temperature sensor plug. See the Figure at the top.
Run the engine at 3200 min^{-1}. Take reading for timing angle.
Disconnect the coolant temperature sensor plug (color of cable green/black). See Figure at the center.
When this is done, the timing angle must change.

Did the timing angle change?

no

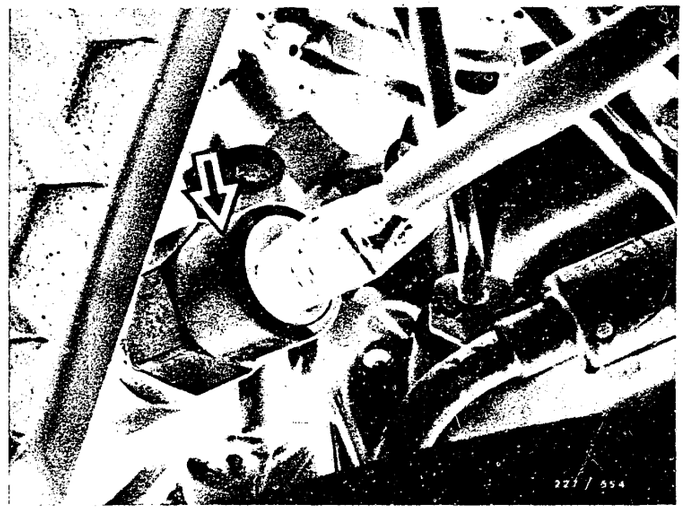
Switch the ignition off.
Disconnect the electronic ignition control plug and connect an ohmmeter to Term. 1 (Figure at bottom) and vehicle ground.
For resistances, see the table.

Coolant temperature		Resistance
+ 20°C	=	2.1...2.9 kΩ
+ 30°C	=	1.4...2.0 kΩ
+ 80°C	=	280...370 Ω
+ 90°C	=	210...280 Ω
+100°C	=	160...215 Ω

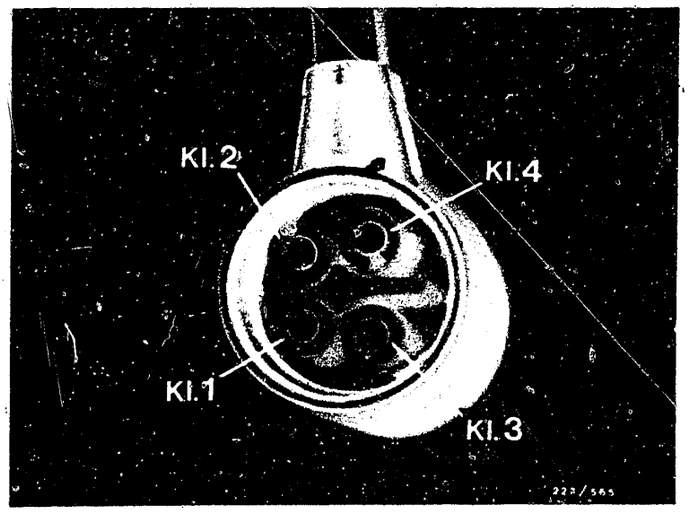
If the ohmmeter reads ∞Ω, then check the lead from the coolant temperature sensor plug (color of cable green/black) to the electronic ignition control unit plug Term. 1 for continuity. Eliminate any break. If the values for resistance deviate, take out and replace the coolant temperature sensor.

yes

Continued on C1/C2





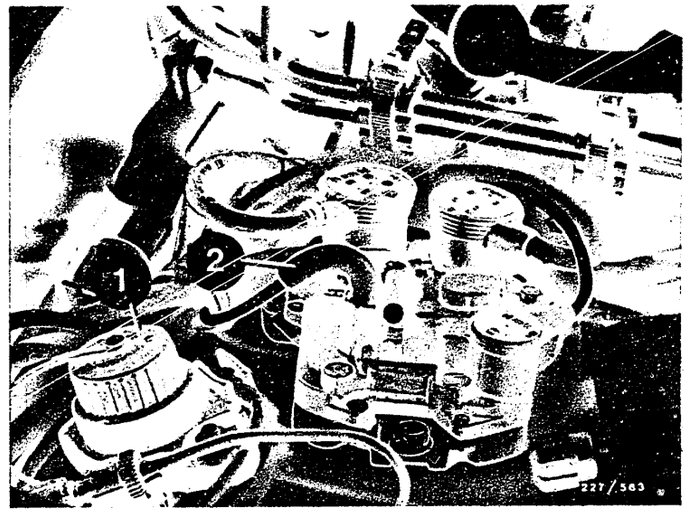


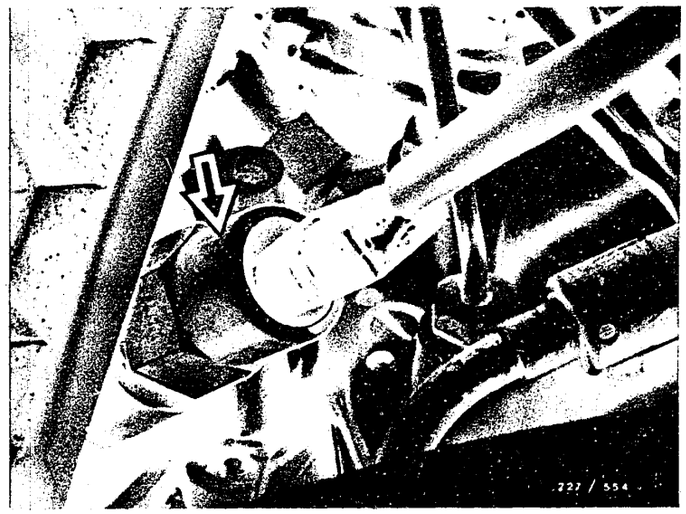
Test <u>trimming plug</u>.

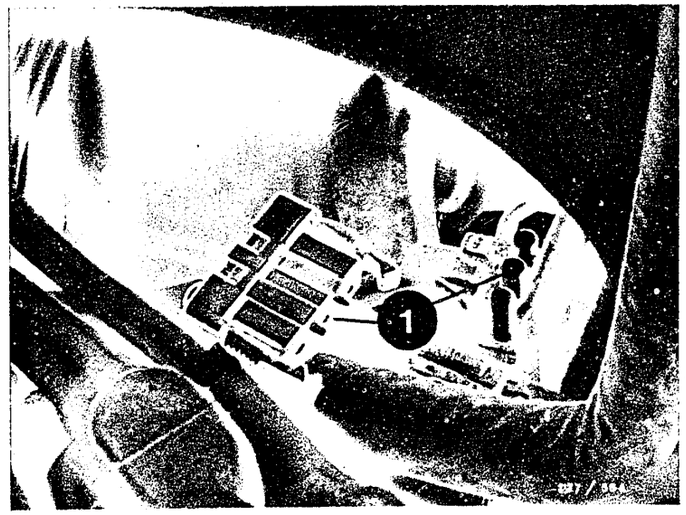
Engine at normal operating temperature.
Connect motortester with adapter lead to diagnostic socket (upper illustration, Item 1).
Disconnect vacuum hose from EI control unit (upper illustration, Item 2).

Disconnect air-intake temperature-sensor plug (arrow, center illustration). Disconnect plug-in connection from throttle-valve switch (lower illustration, Item 1).

Continued on C3/C4







Read off and note down trimming-plug position.
Run engine at idle.
Read off spark-advance angle.
Starting from "Position 1", disconnect trimming plug, adjust and reconnect. See upper illustration.
Set trimming plug to positions 2 to 7 one after the other (only up to position 6 with automatic transmission). Each trimming-plug position corresponds to retardation of the spark-advance angle by approx. 2°.
Spark-advance-angle adjustment O.K.?

no →

Switch off ignition.
Disconnect EI control-unit plug and connect ohmmeter to term. 3 and vehicle ground. Set trimming plug to positions 2 to 7 one after the other.
For resistance values, see table.
Note: A trimming plug marked with EZL in white must be installed.

Trimming-plug position		Resistance value
1	=	∞ Ω
2	=	2,4 kΩ
3	=	1,3 kΩ
4	=	750 Ω
5	=	470 Ω
6	=	220 Ω
7	=	0 Ω

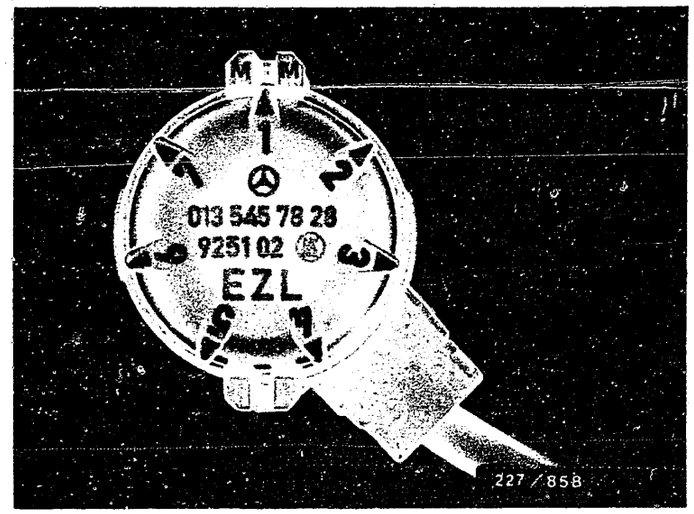
Yes ↓

Return trimming plug to original position.

Yes ↓

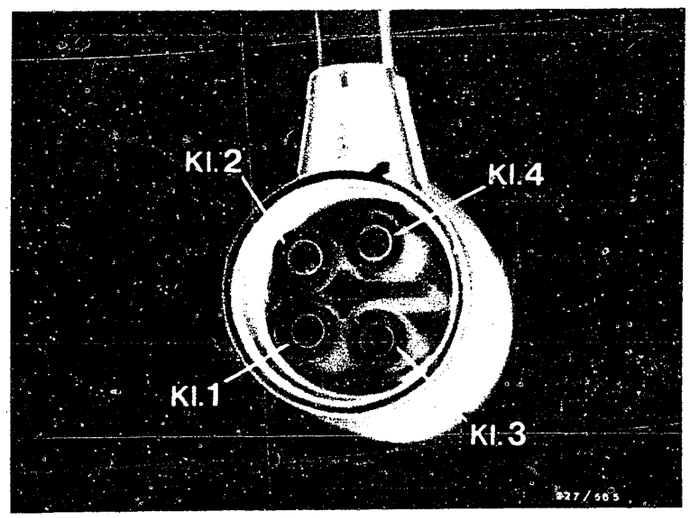
Continued on C7/C8

Continued on C5/C6



Trimming plug

EI control-unit plug

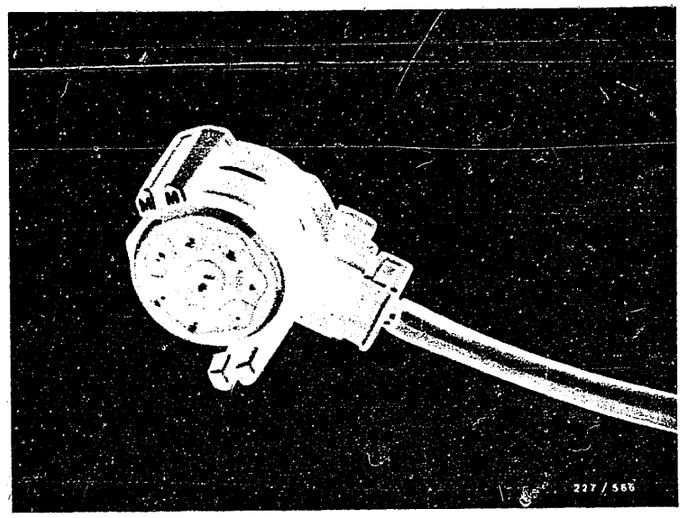


Continued

If <u>resistance</u> was O.K. in all adjustment-plug positions, replace EZ control unit.

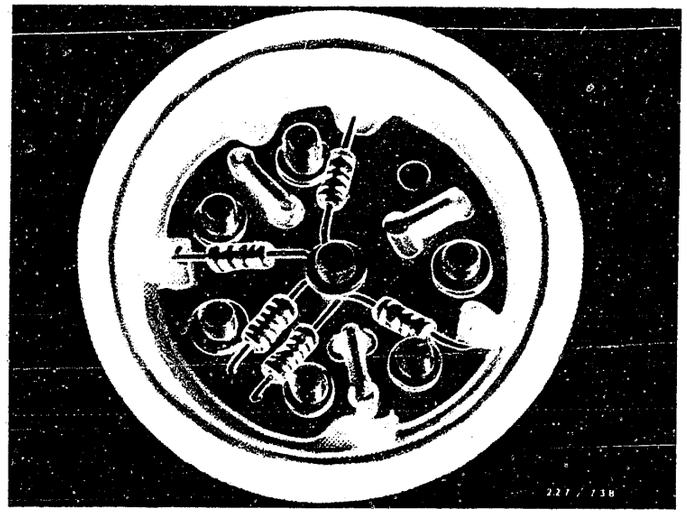
If <u>resistance</u> was <u>approx. 0 Ω or ∞Ω</u> in all adjustment-plug positions, replace adjustment-plug housing without adjustment plug.
See top picture.

If <u>resistance was not within tolerance,</u> replace adjustment plug.
See bottom picture.



Adjustment-plug housing

yes



Adjustment plug (from rear)

Continued on C7/C8

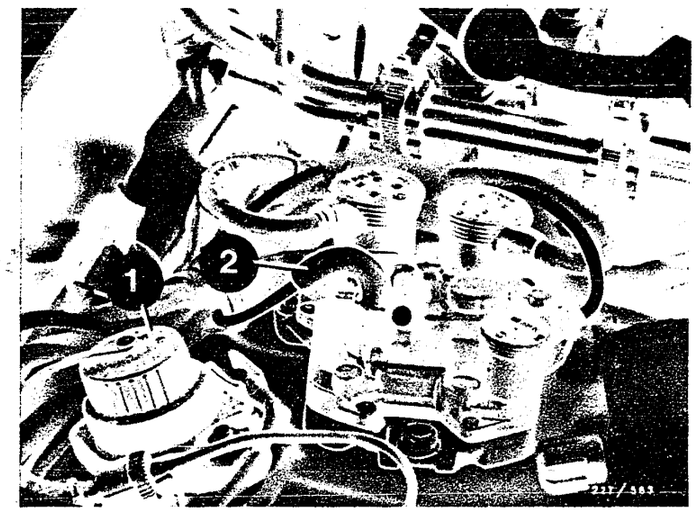
Test spark-advance.
Engine at normal operating temperature, but < approx. 95°C coolant temperature.
Connect motortester using adapter lead to diagnostic socket.
See upper illustration, Item 1. Disconnect vacuum house from EI control unit.
See upper illustration, Item 2.
Disconnect air-intake temperature-sensor plug. See center illustration, arrow.
Disconnect plug-in connection from throttle valve switch.
See lower illustration, Item 1.
Run engine at 3200 \\ 50 min^{-1}
Spark-advance angle must be 18...20° before TDC.
Spark-advance angle O.K.?

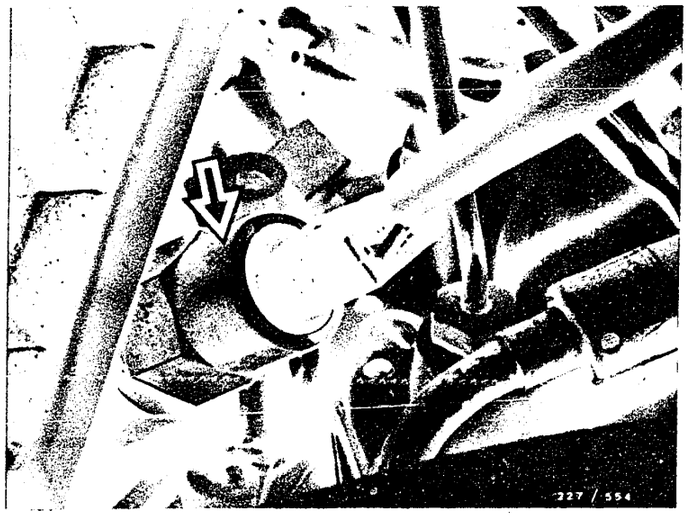
no → Set spark-advance angle by turning the trimming plug.

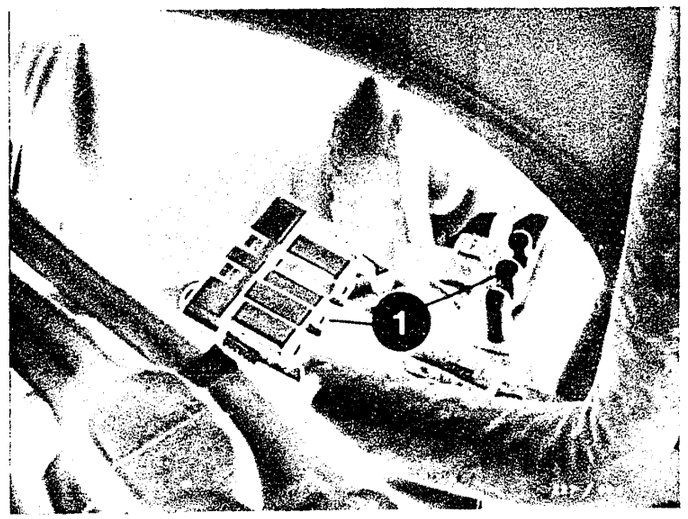
Yes

Continued on C11/C12

Continued on C9/C10

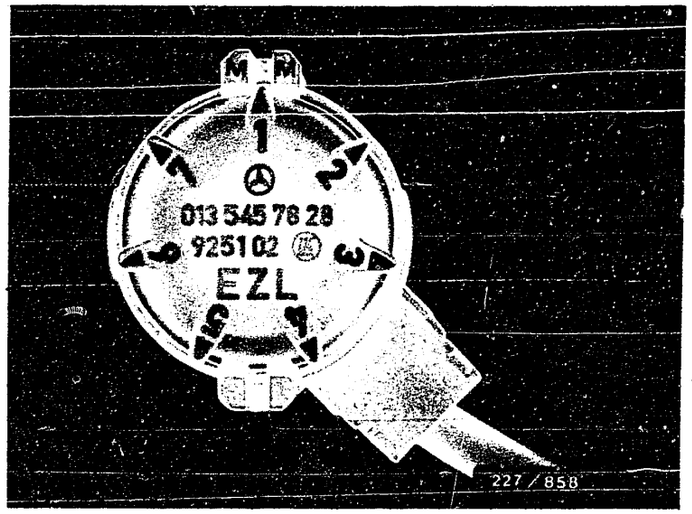






Continued

To do this, disconnect trimming plug, adjust and reconnect.
See illustration. Each trimming-plug position corresponds to retardation of the spark-advance angle by approx. 2°.
If the specified spark-advance angle is not obtained, replace EI control unit.



Trimming plug

Continued on C11/C12

Check the intake air temperature sensor.

1. Switch the ignition off.
Remove the top portion of the air filter.
Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 4 (-) and battery terminal (+).
See the Figure at the top. Switch the ignition on.
Carefully heat the intake air temperature sensor with a suitable source of heat (e.g. a soldering gun, a hair-dryer), to > + 25°C. See Figure at center.
The voltmeter must read approx. 0 V.

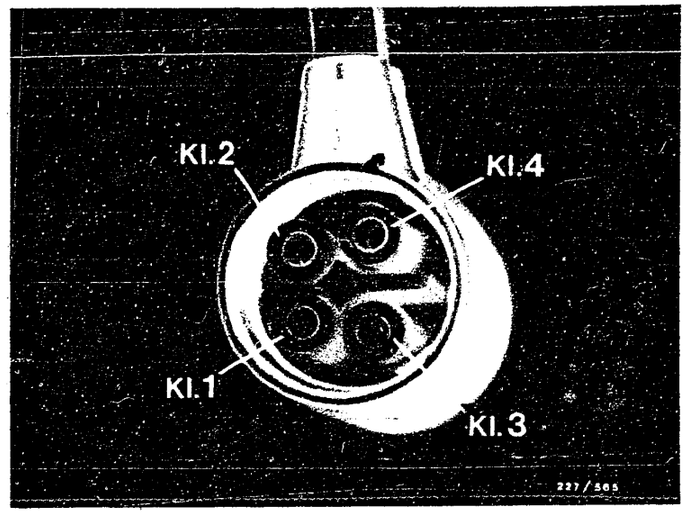
2. Cool the intake air temperature sensor to < + 25°C (e.g. with a refrigerant spray).
The voltmeter must read approx. battery voltage. Are the voltages in points 1 and 2 O.K.?

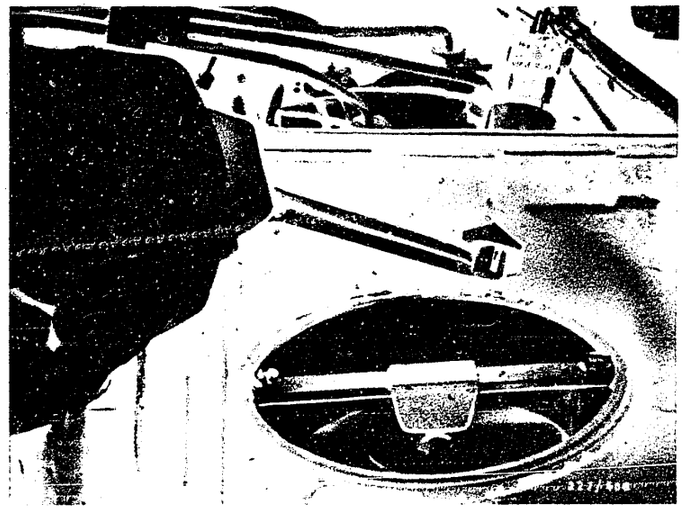
no

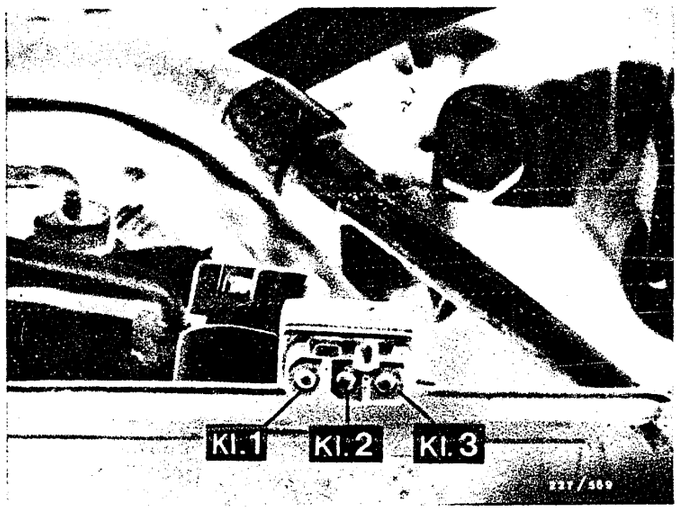
Disconnect the intake air temperature sensor plug. See the Figure at the bottom. Check the lead from Term. 1 (+) and Term. 3 (-) from the intake air temperature sensor and the lead from Term. 2 from the intake air temperature sensor to the electronic ignition control unit plug Term. 4 for a break. Eliminate any break. If there was no break present, take out and replace the intake air temperature sensor.

yes

Continued on C13/C14







Check the idle contact in the throttle valve switch.
Switch the ignition off.
Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 2 and vehicle ground. The throttle valve is in the idle setting. The resistance measured must be approx. 0 Ω (continuity). Open the throttle valve. The ohmmeter must read ∞ Ω.

Are the values for resistance O.K.?

no

1. Disconnect the plug connection from the throttle valve switch. See the Figure at the center. Connect an ohmmeter one after the other to:

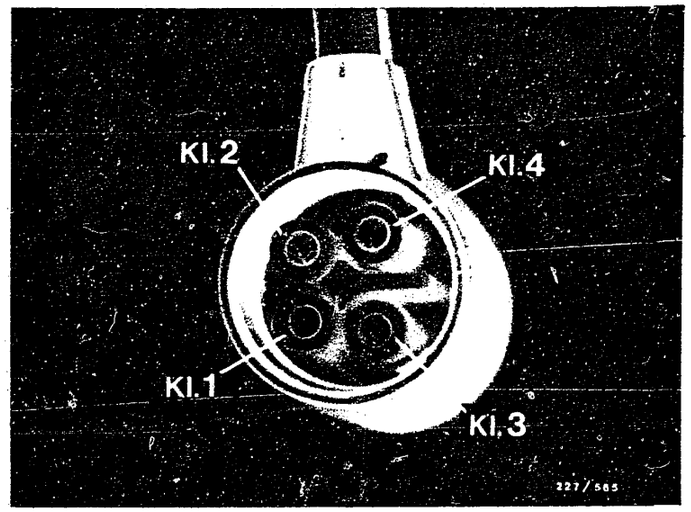
Throttle valve switch plug connection		Electronic ignition control unit plug
Term. 1	and	Term. 2
Term. 2.	and	vehicle ground

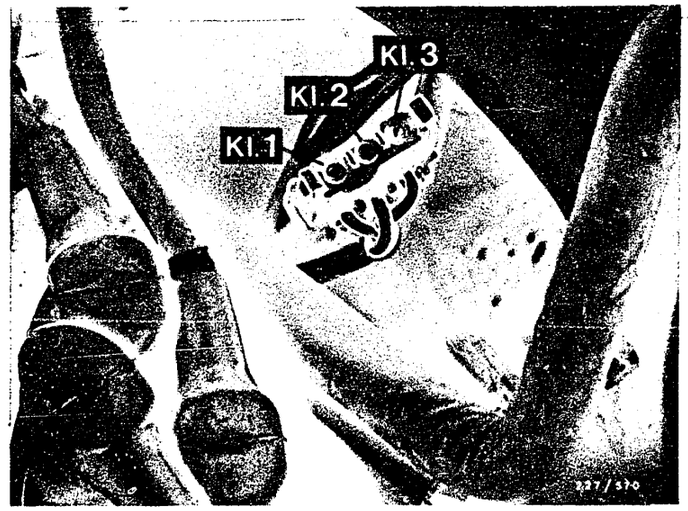
The ohmmeter must read approx. 0Ω (continuity). Eliminate any break.

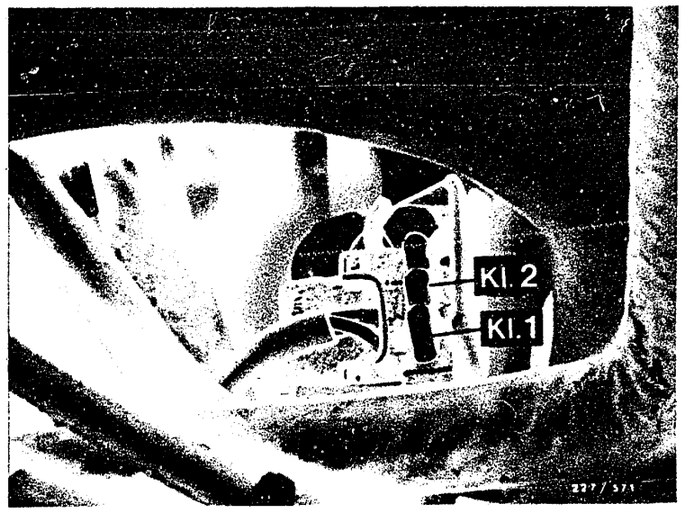
2. Connect the ohmmeter to the throttle valve switch plug connection Term. 1 and Term. 2. See the Figure at the bottom. The throttle valve is closed.
Resistance approx. 0 Ω

Open the throttle valve. The ohmmeter must read ∞Ω.

If resistance not O.K., replace throttle-valve switch.







yes

Continued on C15/C16

Check the voltage supply to the electronic ignition control unit and the ignition coil.

Connect the voltmeter and test prod to the diagnosis socket Term. 5 (+) and the battery terminal (-). See the Figure.
Run the engine at idle.
The voltage measured must be 12 ... 14 V and must not be more than 1 V less than battery voltage.

Is the value for voltage O.K.?

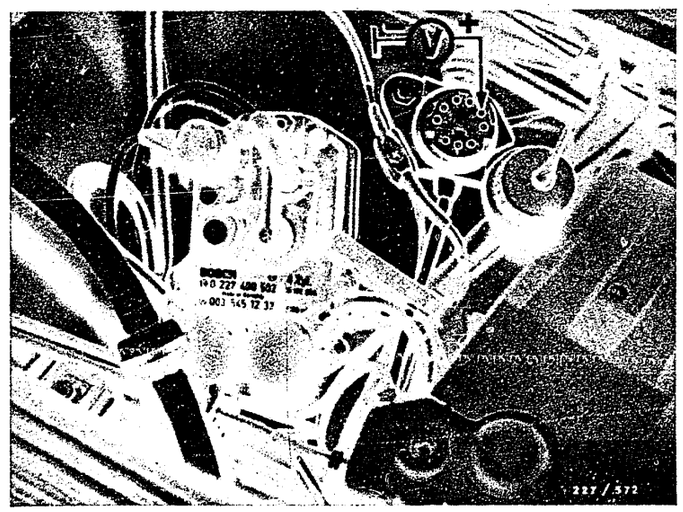
no →

Disconnect the positive lead from the battery. Switch the ignition on. Check the leads from the positive battery terminal to the ignition coil Term. 15 for contact resistance.
Max. contact resistance 0.3 Ω.
(Take the resistance of the measuring lead and the test prods into consideration.)

Eliminate any contact resistance.

yes

Continued on C17/C18



Diagnosis socket

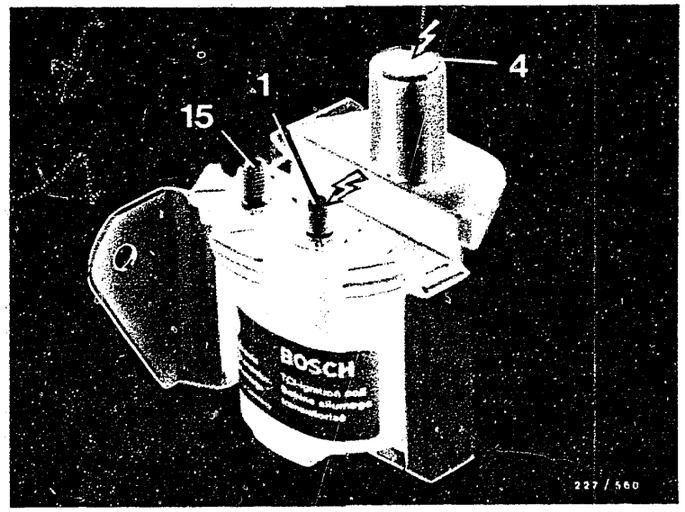
Check the peak coil current cutoff
Connect a voltmeter to the ignition coil Term. 15 and Term. 1. Switch the ignition on. For approx. 1 sec. the voltmeter can move a short distance.
The voltmeter must return to 0 V.
Is the value for voltage (0 V) O.K.?

no

Take out and replace the electronic ignition control unit and the ignition coil.

yes

Continued on C19/C20



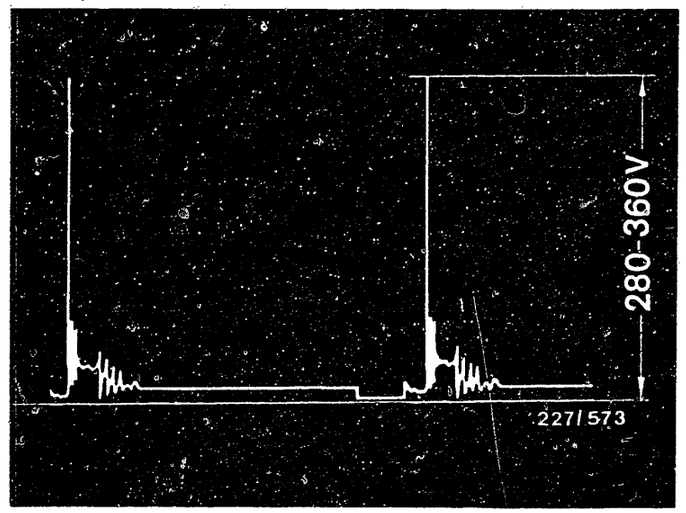
High voltage arrows:
Warning, 400 V...25 kV

Check primary voltage.

(If MOT series available).
Connect oscilloscope (e.g. MOT 201) together with pulse shaper 1 684 463 154 to ignition coil as per operating instructions.
Note: Incorrect reading without pulse shaper. Operate engine at idle.
Measured primary voltage must be 280 ... 360 V.
See graph.

Voltage correct?

no → Replace EZ control unit.



yes ↓

If all test steps O.K. and customer complaint still not remedied, try installing a new specified ignition coil. If customer complaint still not remedied, re-install "old" ignition coil.
Ignition system O.K.
Testing completed.
Tests starting on E1 not necessary.

Note:
Further possible faults on fuel system or engine not mechanically O.K.

No primary voltage or no ignition spark.

(Continued from B9/B10)

yes

Check insulation of pulse generator.

Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 7 and the battery terminal (-). See the Figure at the top. The ohmmeter must read ∞ Ω . Is the value for resistance O.K.?

no → If the value for resistance is approx. 0 Ω, take out and replace the pulse generator. See the Figure at the bottom.

yes

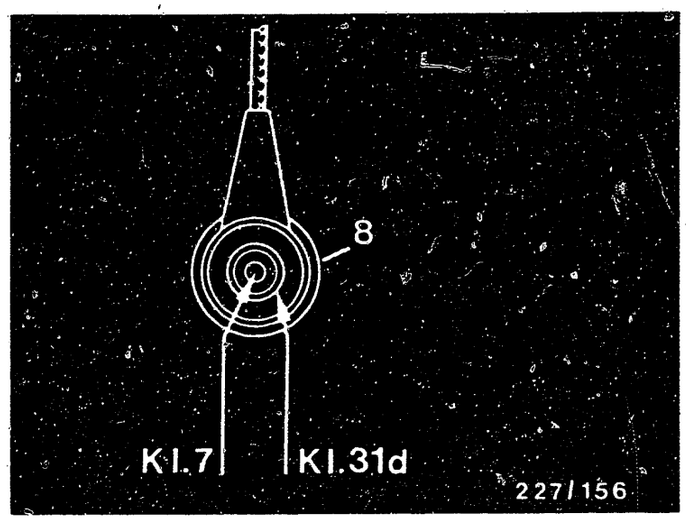
Check the internal resistance of the pulse generator.

Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 7 and Term. 31d. See the Figure at the top. The ohmmeter must read 680 ... 1200 Ω. Is the value for resistance O.K.?

no → Take out and replace the pulse generator. See the Figure at the bottom.

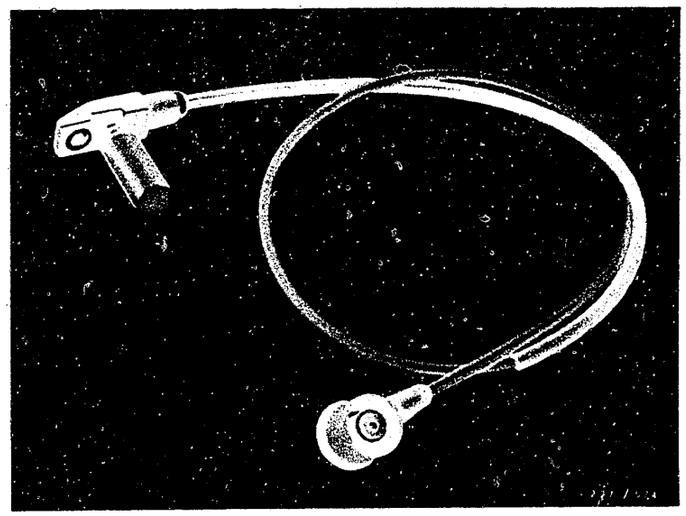
yes

Continued on C23/C24



8=Electronic ignition control unit plug - pulse generator
Kl.=Term.

Pulse generator



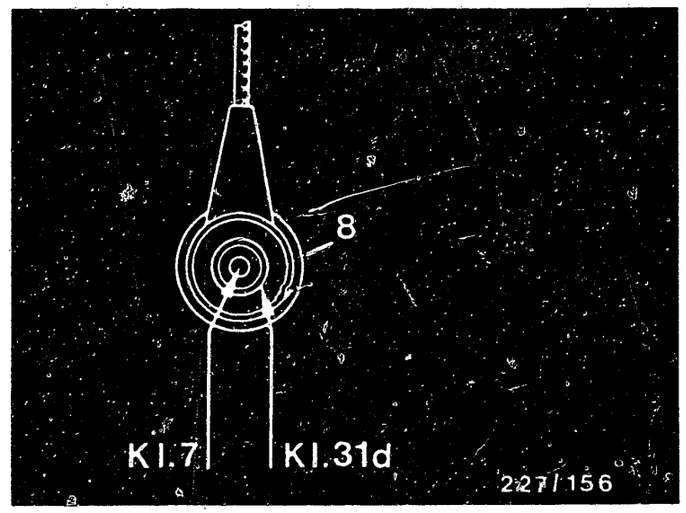
<u>Check pulse-generator voltage.</u>
Connect oscilloscope as per operating instructions with program switch in "special" position.
For example, MOT 201:
Connect red and black clamps to disconnected EZ control-unit plug term. 7 (+) and term. 31d (-). See top picture.
Start engine.
Oscilloscope must indicate a voltage of at least 1 V.
See center diagram.
Voltage correct?

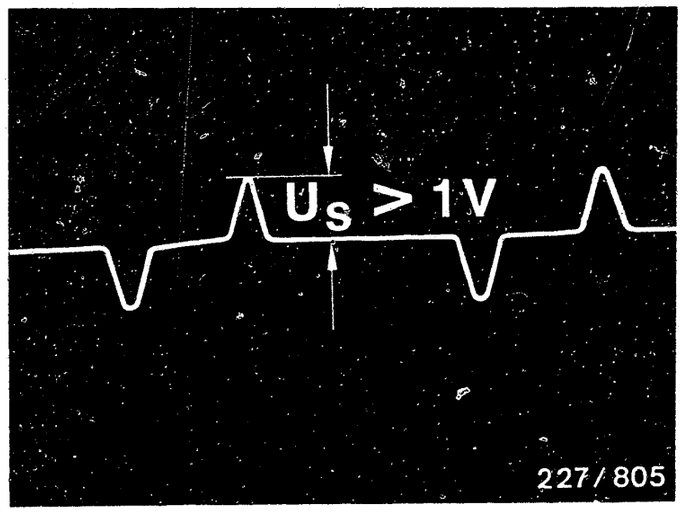
no →

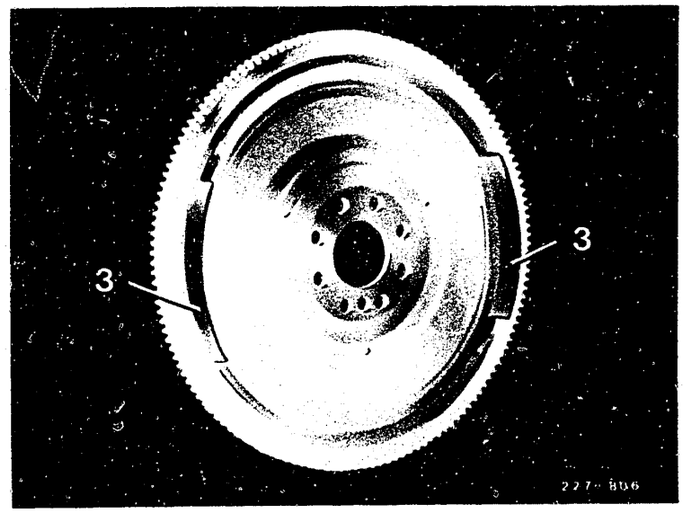
Remove pulse generator and check for mechanical damage.
Using a suitable tool, turn over engine by hand, at the same time checking, through the pulse-generator bore, the 2 segments on clutch plate/
flywheel for mechanical damage. See bottom picture, Item 3.
Replace mechanically defective parts.
If pulse generator and segments mechanically O.K., replace pulse generator (electrically defective).

yes

Continued on D1/D2







Check the voltage supply to the electronic ignition control unit.

Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 15 (+) and Term. 31 (-). See the Figure.
Switch the ignition on.
The voltmeter must show battery voltage.

Is the value for voltage O.K.?

no → Check the leads and connections from the ignition and starting switch to the electronic ignition control unit plug Term. 15, including the ground lead Term. 31, for a break. Eliminate any break.

yes ↓

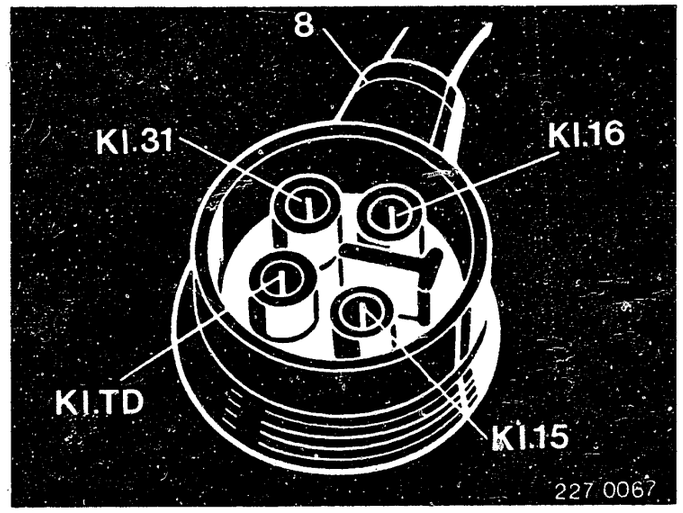
Check the primary circuit.
Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 16 (+) and Term. 31 (-). See the Figure.
Switch the ignition on.
The voltmeter must indicate battery voltage.

Is the value for voltage O.K.?

no → Check the supply lead from the ignition and starting switch to the ignition coil Term. 15, the primary winding of the ignition coil, and the lead from the ignition coil Term. 1 to the electronic ignition control unit plug Term. 16, including the ground lead, Term. 31, for a break. Eliminate any break.

yes ↓

Continued on D3/D4



8=Electronic ignition control unit plug
Kl.=Term.

Check ignition coil.

Remove protective cap from ignition coil.

Ignition coil, primary (term. 15 and term. 1)
0.30 ... 0.60 Ω (take resistance of test lead with test prods into account).
Ignition coil, secondary (term. 1 and term. 4)
7.3 ... 13.2 kΩ.

Resistance O.K.?

no → Replace ignition coil.

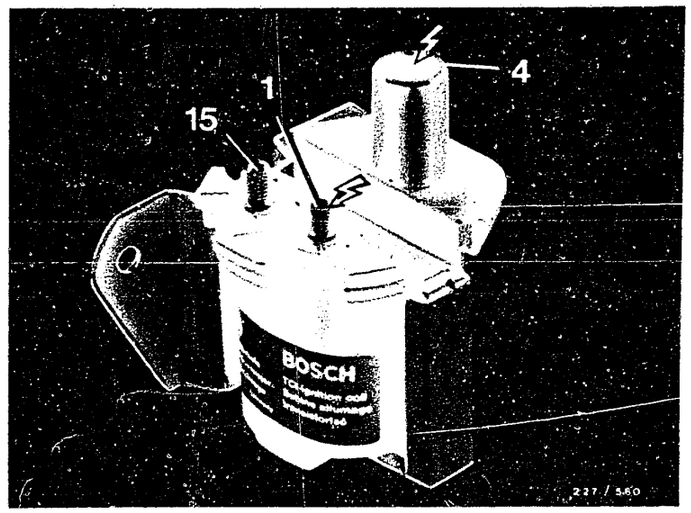
yes ↓

If all test steps were O.K. and still no primary signal/ignition spark, try installing a new specified ignition coil.
If primary voltage/ignition spark still not present, re-install "old" ignition coil and replace EZ control unit.

Testing completed

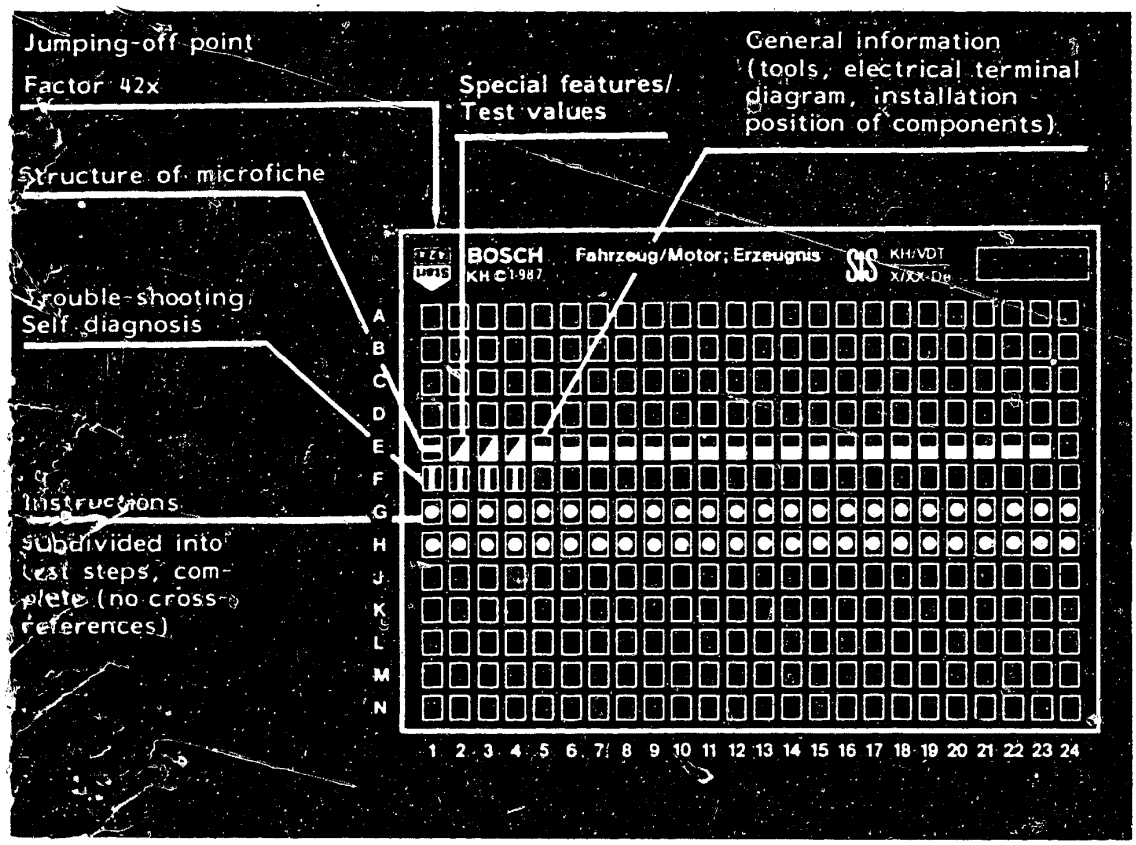
Tests from B 11 not necessary.

Note:
If customer complaint still not remedied, further possible faults on fuel system, or engine not mechanically O.K.



Danger arrows:
Warning: 400V ... 25 kV

Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step
	Vehicle/engine

Coordinate

3. Limits of section

Beginning | Mid-section | End | One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6

C6

1. Special features

190 E 2.3 - 16, 4-cyl. engine 102.983 version ECES/KAT 1985 model year world-wide except USA, J, AUS (with transmission-overload protection on automatic transmission.
Equipped with:
EI control unit 0 227 400 630, ..642 (with current limitation) or
Siemens AG control unit (Daimler-Benz AG service part).
Note: Bosch and Siemens control units are interchangeable.
Ignition coil 0 221 5..

2. Test specifications

G11

Ignition coil, primary	0.3 ... 0.6 Ω
Ignition coil, secondary	7.3 ... 13.2 kΩ

G17

Transmission-overload--protection switch	
Driving position "N" or "P"	> 20 kΩ
Driving position "D"	< 1Ω

G23

Coolant-temperature sensor	+ 20°C	2.1 ... 2.9 kΩ
	+ 30°C	1.4 ... 2.0 kΩ
	+ 80°C	280 ... 370 Ω
	+ 90°C	210 ... 280 Ω
	+ 100°C	160 ... 215 Ω

G17

Spark-advance angle without vacuum
Vehicles WITH catalytic converter

H3

Fuel	Adjustment plug EZL KAT (green)	Speed min^{-1} or °crankshaft BTDC
Premium unleaded	Position S	4000 18–22°
Regular unleaded	Position N	4000 13–17°

To avoid incorrect adjustment, always test in accordance with instructions from the coordinates.

Spark-advance angle without vacuum
Vehicles WITHOUT catalytic converter

G17

Fuel	Adjustment plug EZ ECES (white)	Speed min^{-1} /°crankshaft BTDC
Premium unleaded /leaded	Position S	4000 18-22°
Regular unleaded /leaded	Position N	4000 13-17°

H3

To avoid incorrect adjustment, always test in accordance with instructions from the coordinates.

Adjustment-plug position, version

H4

	EZ * ECES	EZL-** KAT
* Code colour: white ** Code colour: green	S	1 = ∞ Ω
	2	2 = 2.4 kΩ
	N	3 = 1.3 kΩ
	4	S = 750 Ω
	5	5 = 470 Ω
	6	N = 220 Ω
	7	7 = 0 Ω

Air-intake temperature sensor	> + 25°C	0 V
	< + 25°C	approx. batt. +ve

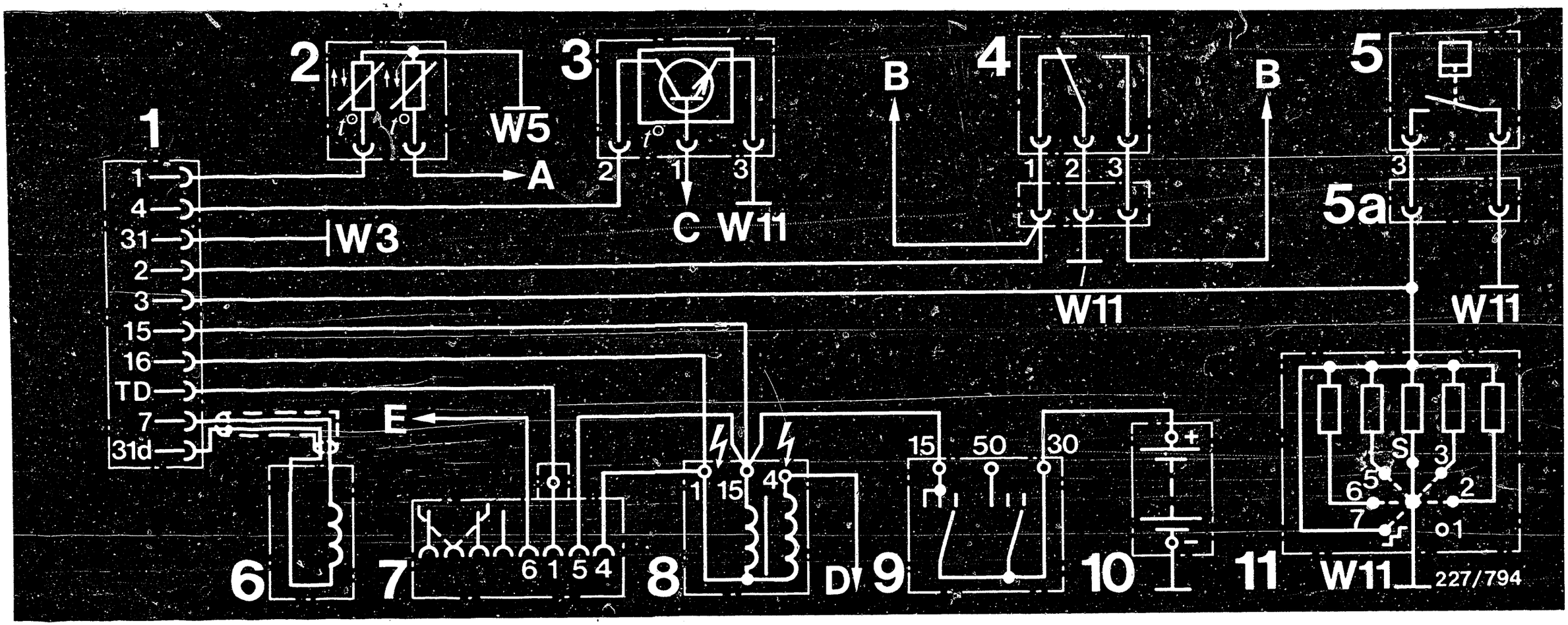
H7

Throttle-valve-switch idle contact	
Idle position	approx. 0 Ω
Throttle valve open	∞Ω

H9

Voltage supply, EI control unit and ignition coil with engine at idle	12 ... 14 V max. 1 V below batt. +ve	H11
Peak-coil-current cutoff approx. 1 s after ignition "ON"	0 V	H13
Primary voltage with engine at idle	280 ... 360 V	H15
Insulation, pulse generator	∞Ω	H17
Internal resistance, pulse generator	680 ... 1200 Ω	
Voltage, pulse generator at cranking speed	U_S > 1 V	
Voltage, EI control unit with ignition "ON"	batt. +ve	H21
Voltage, primary circuit with ignition "ON"	batt. +ve	

See Autodata test specifications for the settings for idle speed, exhaust gas, valve clearance etc.



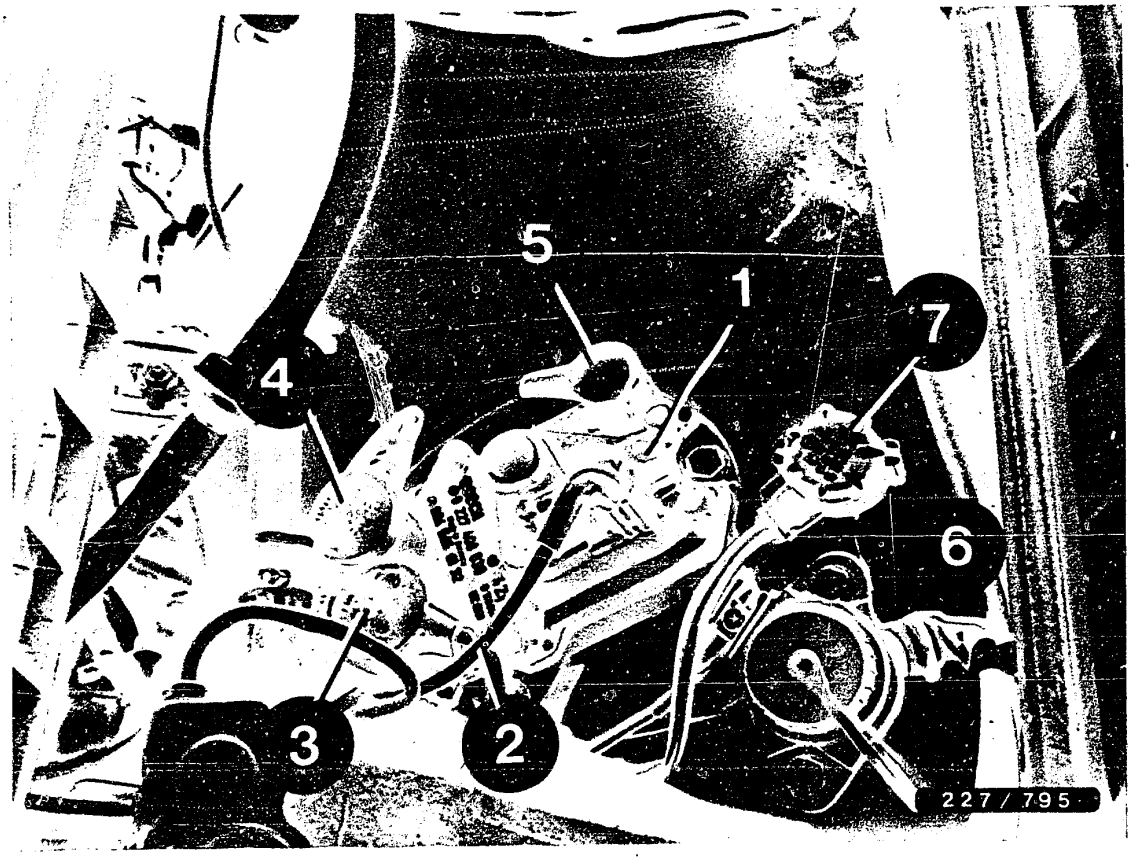
Danger arrows:
Warning: 400 V ... 25 kV

1 = EZ control unit
2 = Coolant-temperature sensor (double NTC)
3 = Intake-air temperature sensor (with switching electronics + 25°C)
4 = Throttle-valve switch
5 = Transmission overload-protection switch (automatic transmissions only)
5a= Transmission overload-protection switch plug connector
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition/starting switch
10 = Battery
11 = Adjustment plug e.g. EZL KAT

A = to KE-Jetronic control unit
B = to KE-Jetronic control unit
C = to central-electrics box connector U, no. 6
E = to central-electrics box connector S no. 11 (term. 30)
D = to high-voltage distributor

W3 = Ground, wheel housing, left of ignition coil
W5 = Ground, engine
W11= Ground, engine (electrical lead srewed on)

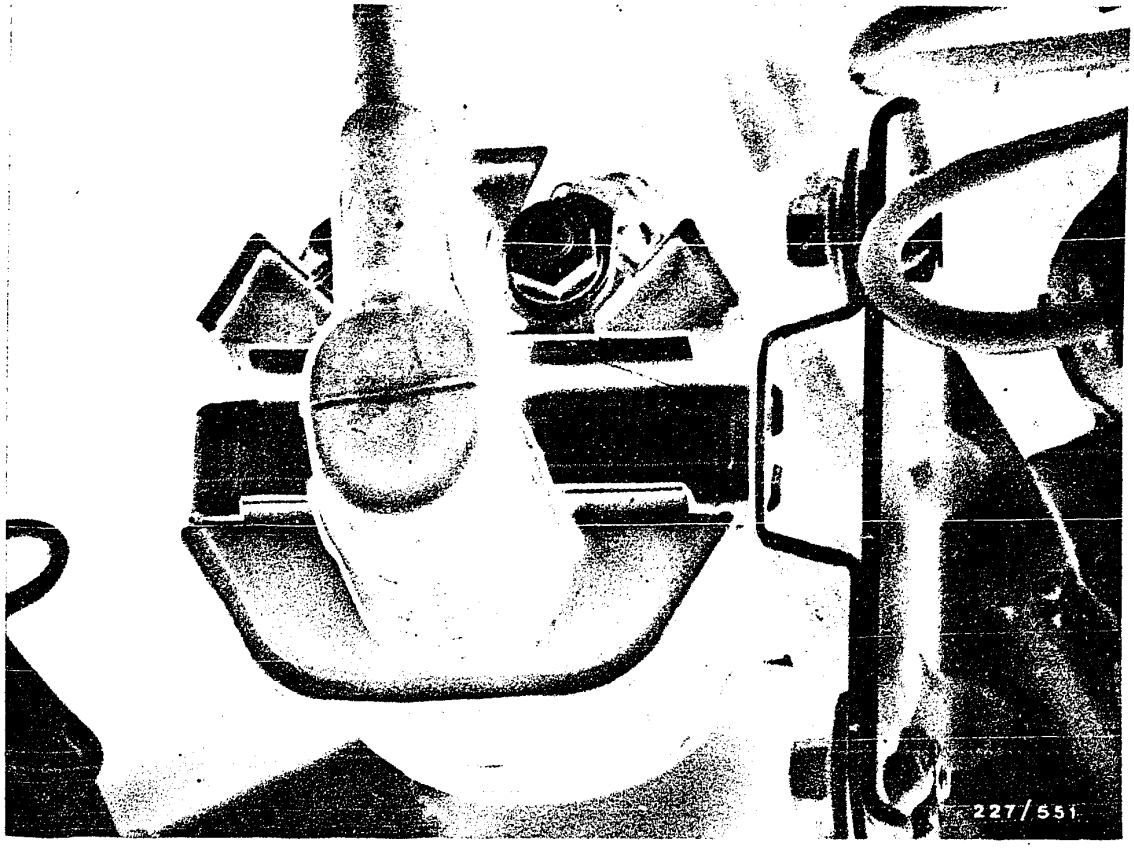
3. Electrical terminal diagram



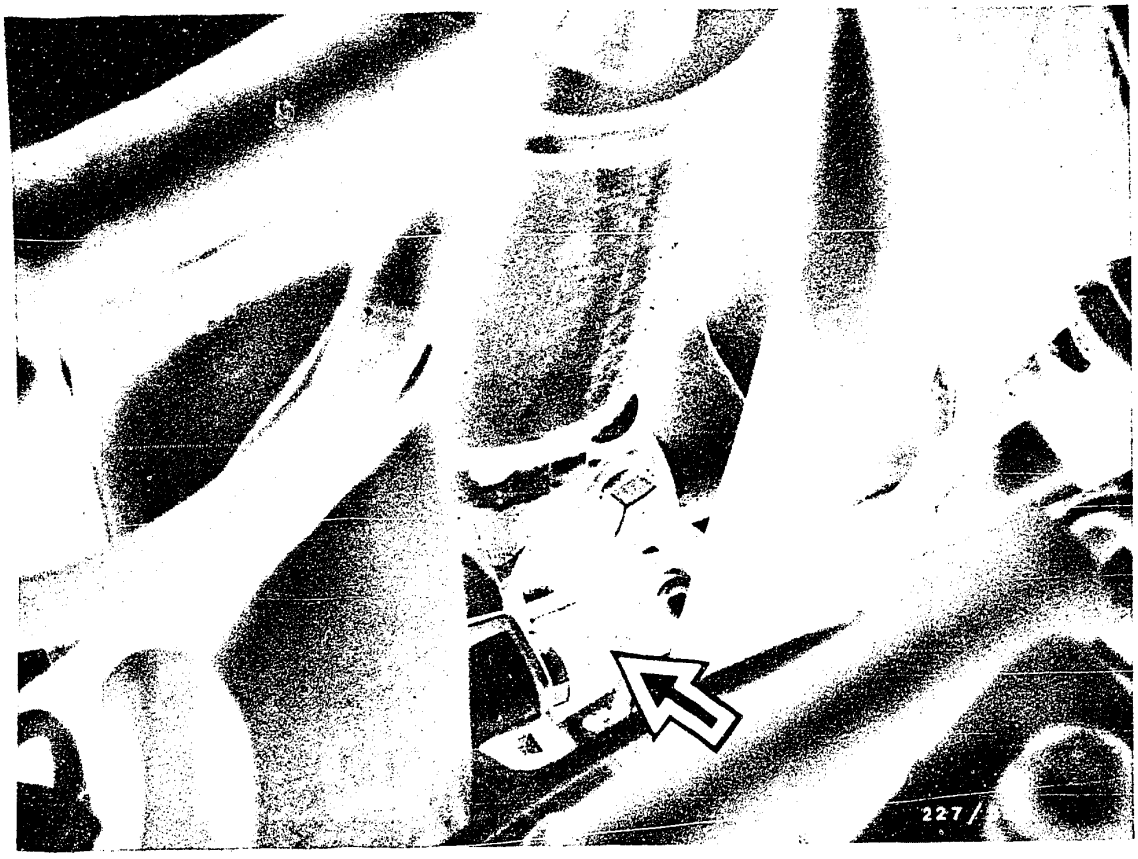
1 = Electronic ignition control unit
2 = Vacuum hose
3 = Quadruple plug - power supply
4 = Quadruple plug - sensor
5 = Coaxial plug - pulse generator
6 = Diagnosis socket
7 = Ignition-adjustment plug

4. Installation position of the components

The control unit and diagnostic socket are on the wheel housing on the left-hand side as viewed in the forward direction of travel.

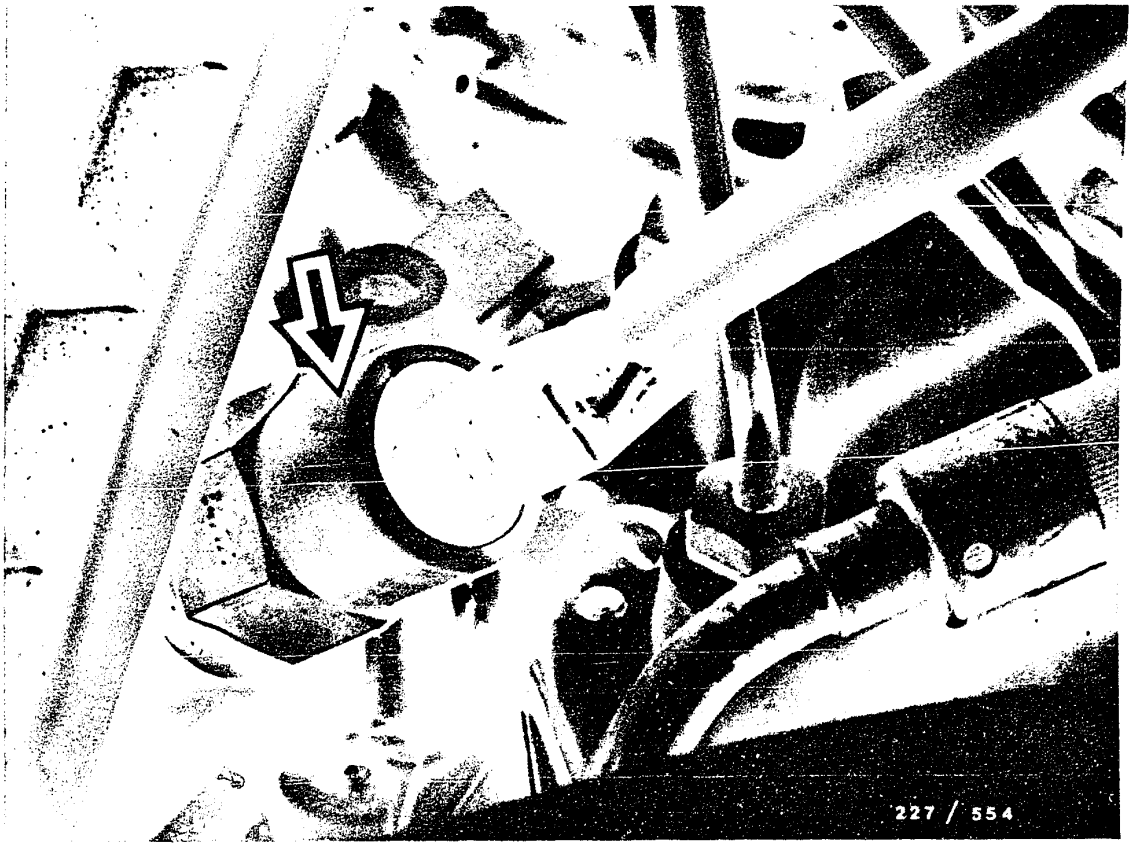


Plastic ignition coil



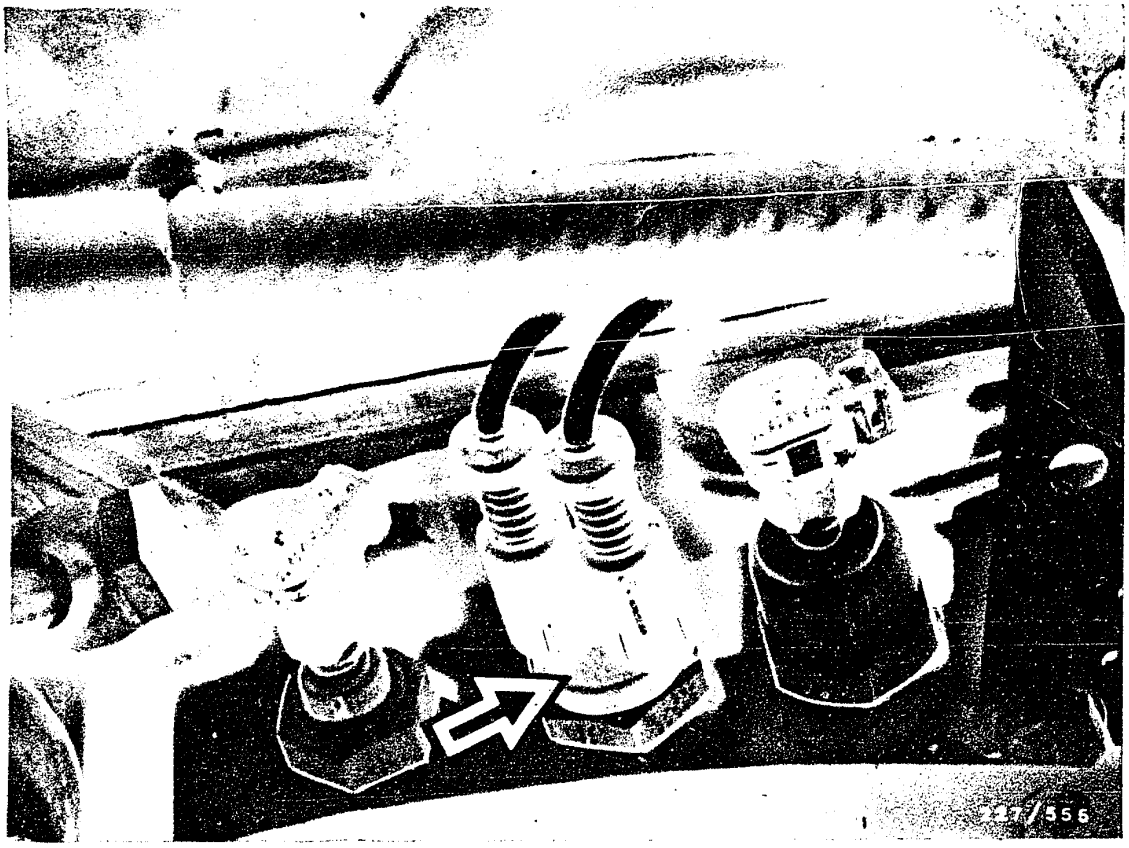
Arrow = Pulse generator

The pulse generator is located on the engine block on the left, looking in the direction of forward vehicle travel (below the oil filter).



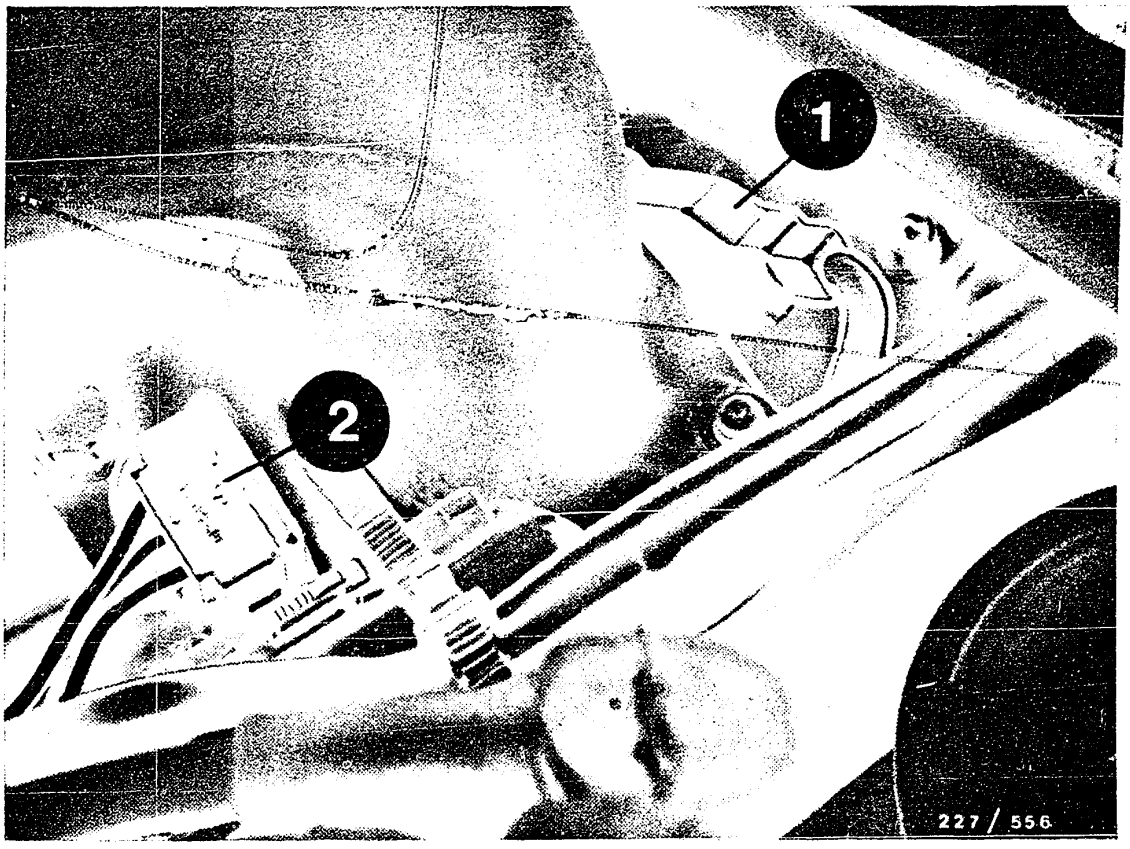
Arrow = Intake air temperature sensor with electronic switch + 25°C

The intake air temperature sensor is located on the air filter.



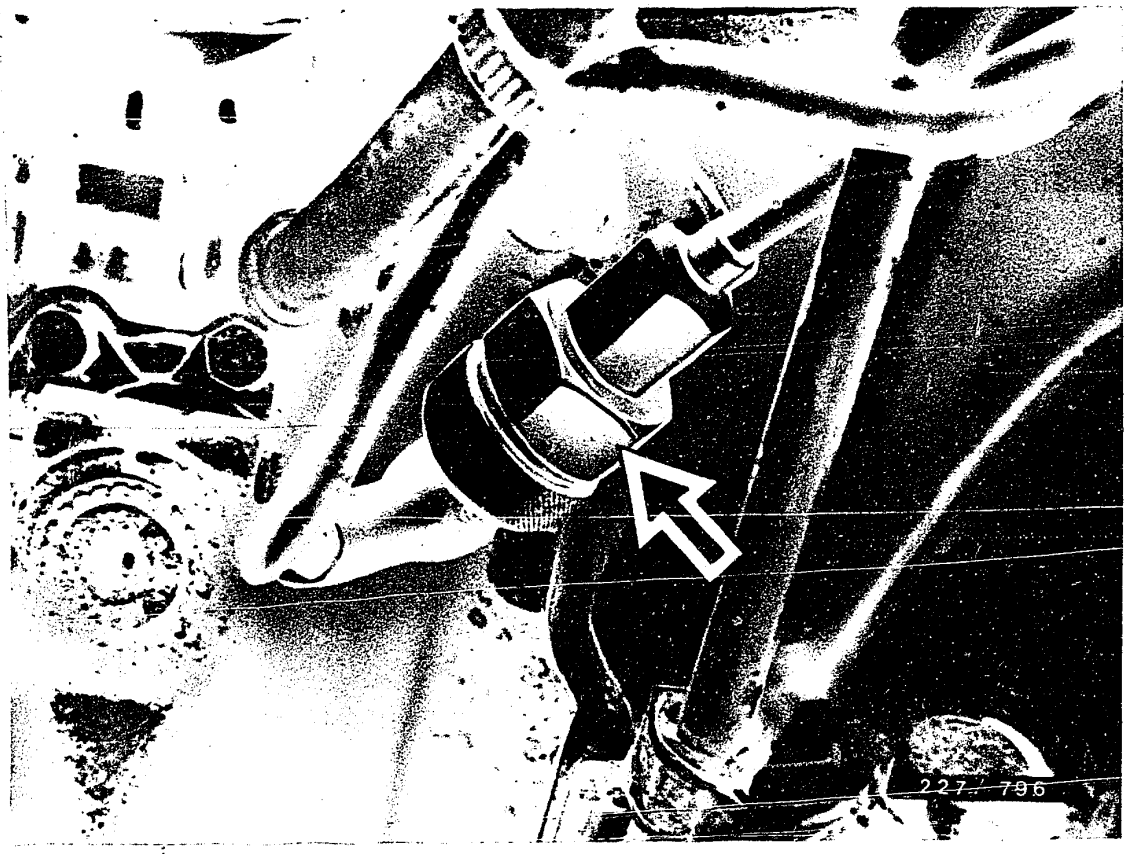
Arrow = Coolant temperature sensor (double NTC)

The coolant temperature sensor is located at the front on the cylinder head (thermostat housing).



1 = Throttle-valve switch
2 = Plug connection from the throttle valve switch

The throttle-valve switch is located on the throttle-valve assembly.



Arrow = Transmission overload-protection switch
(automatic transmissions only)

5. Necessary test equipment and auxiliaries

Motortester e.g.	MOT 201	0 684 000 201
Pulse shaper (is required for measuring the primary voltage with MOT 201, 202, 206 and 400)		1 684 463 154
Adapter lead for diagnostic socket		1 684 463 094
Spark gap e.g. ignition-coil/ condenser tester	EFAW 106 A	0 681 100 001
or single spark gap	EF 1177/7	1 684 531 000
5 kΩ sleeve-type suppressor		0 356 500 001
Ohmmeter	ETE 014.00	0 684 101 400
or e.g.	Pontavi Wh 2	commercially available
Voltmeter e.g.	ETE 014.00	0 684 101 400
Thermal-conduction paste		5 942 860 003
Test prod, black		1 684 485 034
Test prod, red (for correct connection of test equipment at connectors)		1 684 485 035
Refrigerant spray	Testing of intake-air temperature sensor	commercially available
Hairdryer or solder gun		commercially available

6. Danger of accident on electronic ignition systems

Increased demands of modern engines on the ignition system combined with the desire for freedom of maintenance have recently led to electronic ignition systems being fitted as standard. Usually the ignition power of electronic systems (of almost all manufacturers) is higher than that of conventional systems, and there are signs of further increases in power. Electronic ignition systems thus reach a power range which can be highly dangerous if live parts of terminals are touched (both on the primary as well as the secondary sides).

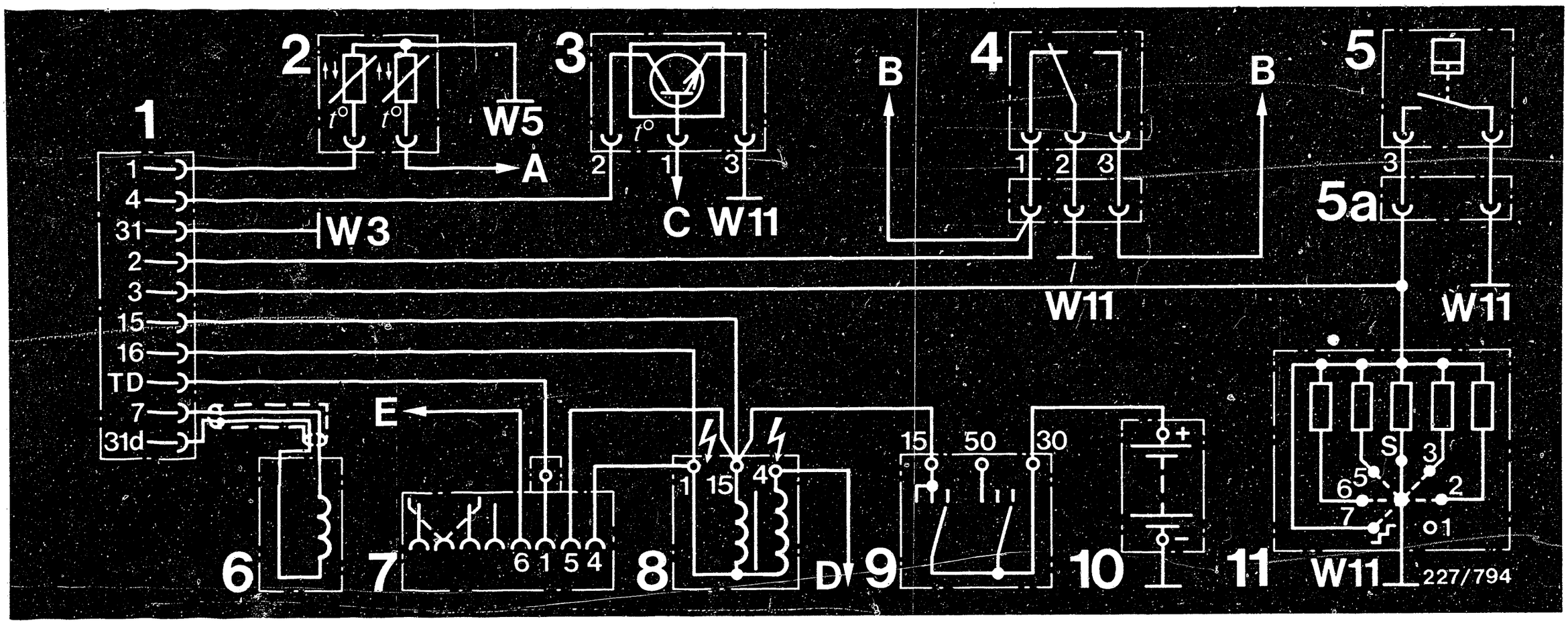
In this connection we should like to point out that the VDE regulations, in particular VDE 0104/7.67 and/or the respective national regulations must be followed when testing or working on the ignition system.

The ignition should always be switched off when working on the ignition system (switch off ignition or voltage source). Such work includes:

- Connecting of engine test equipment (timing light, dwell-tach tester, ignition oscilloscope etc.).
- Replacing parts of the ignition system (spark plug, ignition coil, ignition distributor, ignition cable etc.).

If, while testing the ignition system or during adjustment work on the engine (e.g. KE-Jetronic), it becomes necessary to switch on the ignition (switch on ignition or voltage source), the above-mentioned dangerous voltages occur over the entire system.

The danger of accident exists, therefore, not only on the individual assemblies of the ignition system (e. g. ignition distributor, ignition coil, trigger box, ignition harness), but also on the wiring harness (e. g. tachometer connection, diagnostic plug), at plug-in connections and test equipment.



Danger arrows:
Warning: 400 V ... 25 kV

1 = EZ control unit
2 = Coolant-temperature sensor (double NTC)
3 = Intake-air temperature sensor (with switching electronics + 25°C)
4 = Throttle-valve switch
5 = Transmission overload-protection switch (automatic transmissions only)
5a= Transmission overload-protection switch plug connector
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition/starting switch
10 = Battery
11 = Adjustment plug e.g. EZL KAT

A = to KE-Jetronic control unit
B = to KE-Jetronic control unit
C = to central-electrics box connector U, no. 6
E = to central-electrics box connector S no. 11 (term. 30),
D = to high-voltage distributor

W3 = Ground, wheel housing, left of ignition coil
W5 = Ground, engine
W11= Ground, engine (electrical lead srewed on)

Electrical terminal diagram

7. Incorrect indication of engine speed, dwell angle and ignition point

In the case of ignition systems with control unit 0 227 400 5.., 6.. or control units from Siemens (electr. ignition) with current limitation, there can be an incorrect reading for engine speed, dwell angle, and ignition timing on the test instruments.

For further details see coordinates N 7 - N 10

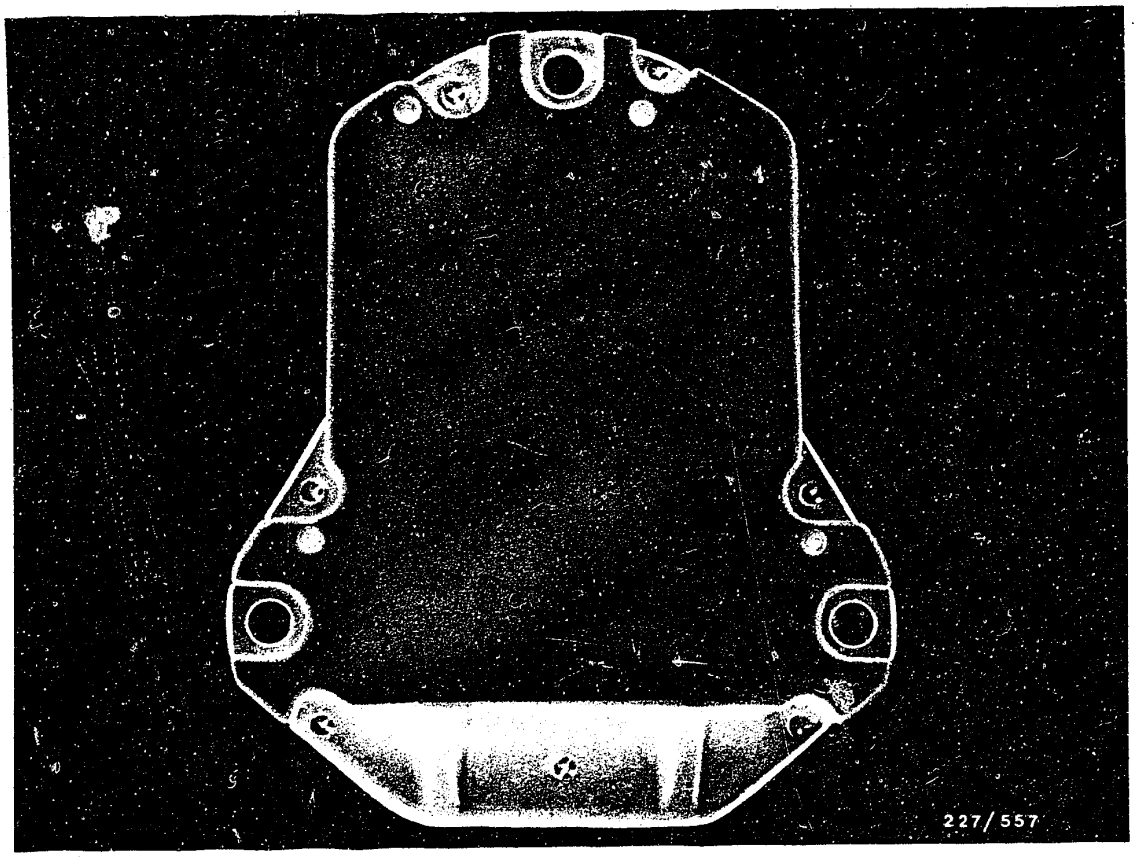
8. Important vehicle information

- Resistance measurements must only be performed with the ignition switched off or with the battery disconnected (measuring instrument defective).
- For a compression test, disconnect the coaxial plug (pulse generator) from the electronic ignition control unit.
- Never disconnect the battery while the engine is running.
- A starting assist with more 16 Volts or with a quick-charger is not permitted.
- The specified ignition coil (see Part.No.) must not be replaced with a different ignition coil.
- No suppression capacitor must be connected to ignition coil terminal 1.
- Ignition coil terminal 1 must not be brought into contact with ground as a theft-proofing measure (ignition coil will be destroyed when ignition is switched on).
- No battery + or test lamp must be connected to ignition coil terminal 1 (the electronic ignition control unit is destroyed).
- The ignition lead from the ignition coil Term. 4 to the high voltage distributor Term. 4 must not be disconnected during operation.
- There must be no arcing from ignition coil terminal 4 to ignition coil terminal 1 and 15.
 The electronic ignition control unit can be destroyed.

- If the poles are reversed on the ignition coil (Term. 1 and Term. 15) there are severe losses of ignition energy, causing missing. In addition, the electronic ignition control unit is overloaded. In order to preclude reversal of poles, the terminal studs have different diameters. (M5 and M6)

- In order to avoid destruction of the electronic ignition control unit, the secondary end of the ignition system must have interference suppression of min. 2 kΩ. The original distributor rotor must be installed with an interference suppression resistor of 1 kΩ. (Do not use a 5 kΩ distributor rotor for radio and interference suppression either.)

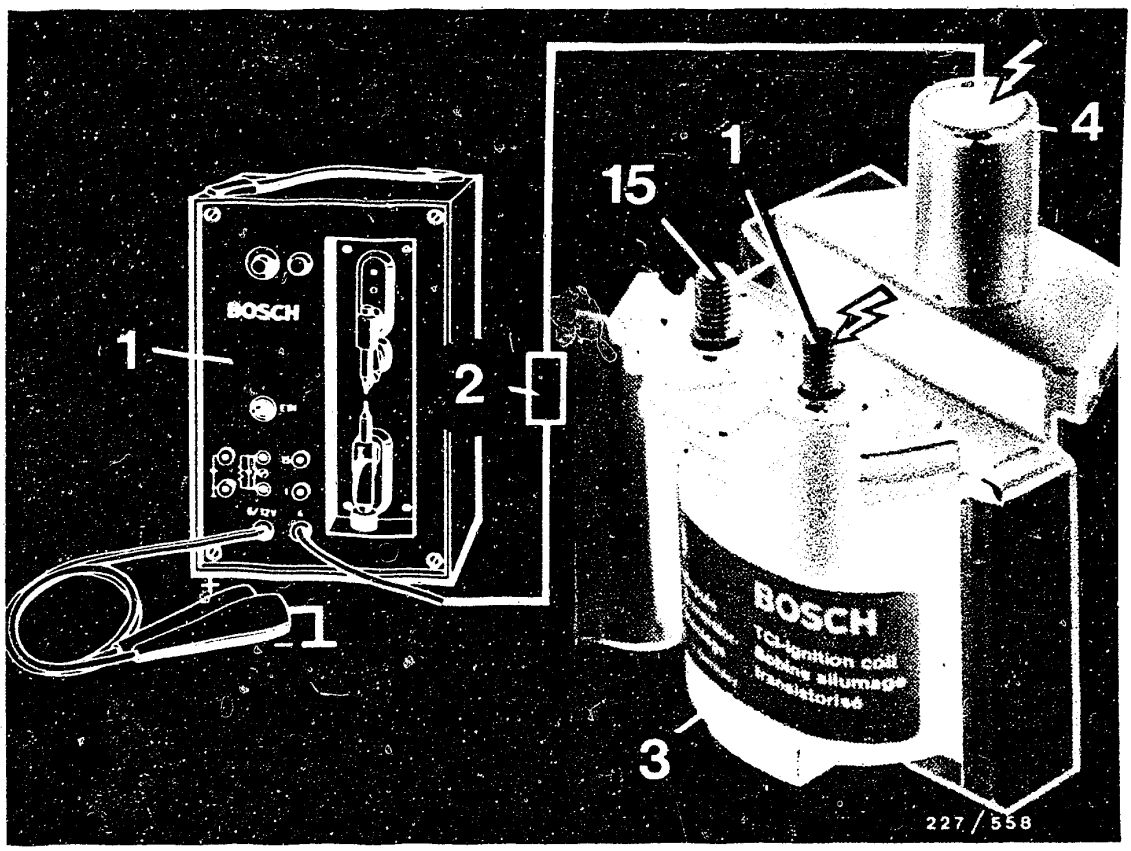
- If the poles on the battery are incorrectly connected, the electronic ignition control unit and the ignition coil are destroyed.



- Before putting on the electronic ignition control unit, the base plate (see the Figure, bright surface) must be coated with a heat conduction paste.

 Before mounting the trigger box, the base plate must be coated with thermal conduction paste. Apply thermal conduction paste only with a suitable object (screwdriver, etc.).

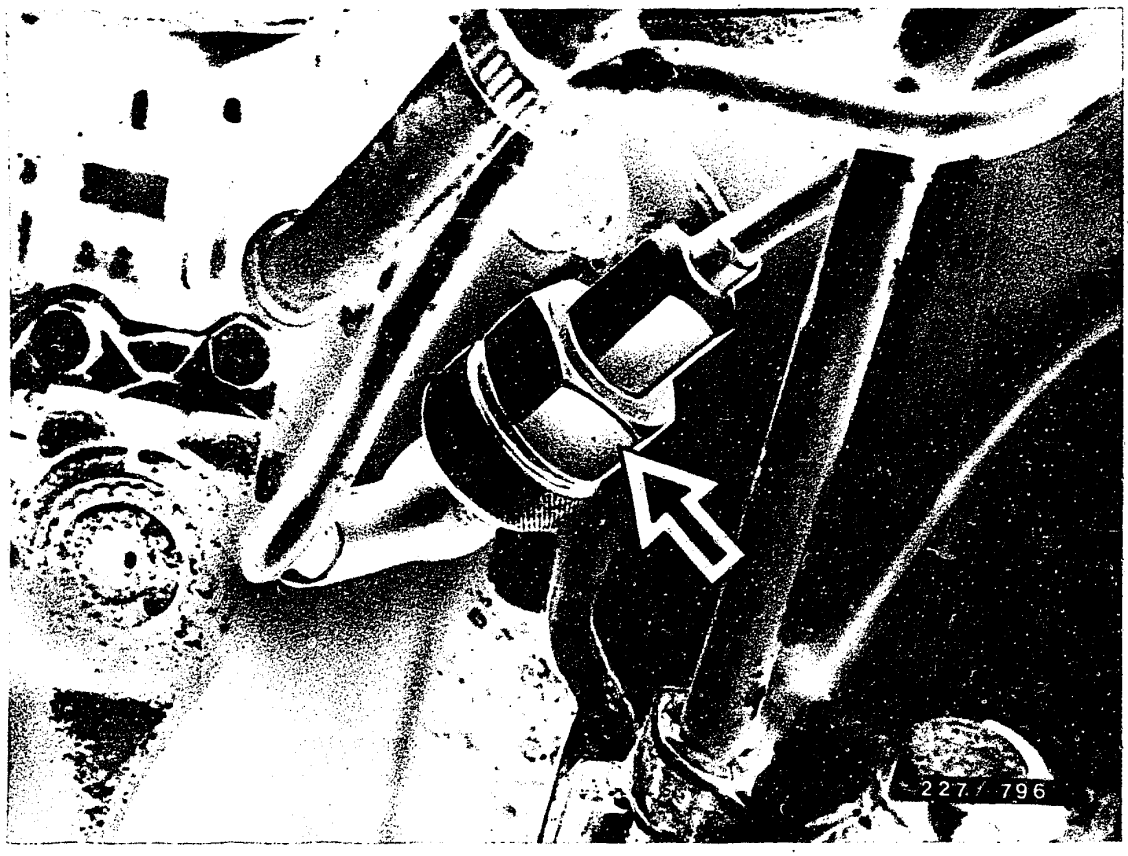
 Do not apply thermal conduction paste to painted parts.



High voltage arrows:
Warning, 400 V ... 25 kV!

1 = Spark gap
2 = 5 kΩ sleeve-type suppressor
3 = Ignition coil

- In order to prevent the trigger box from being irreparably damaged, when using a spark gap, an interference-suppression resistor of at least 2 kΩ must be connected between the spark gap and ignition coil terminal 4, e. g. sleeve-type suppressor (5 kΩ) 0 356 500 001.



Arrow = Transmission-overload-protection switch

In order to prevent the brake bands of the transmission from being overloaded when shifting up gear, the ignition point is retarded to TDC for a brief moment (0.4 s) by the EI control unit . Control/triggering is by means of the transmission overload-protection switch. See picture, arrow.

Note: If the transmission overload-protection feature is defective, the EZ control unit operates in limp-home mode.

Adapting the ignition timing to available fuel

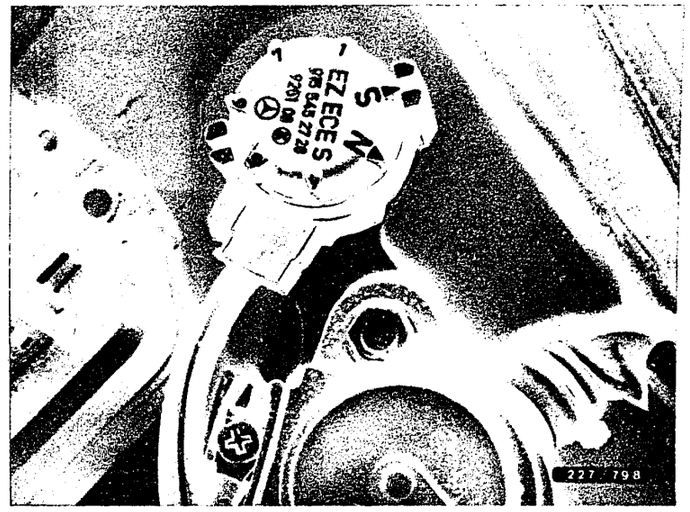
1. General

These vehicles can be run on PREMIUM and REGULAR FUEL - leaded or unleaded. For this, the ignition timing must be set accordingly.
To adjust, pull out adjustment plug as far as it will go, turn to appropriate position and plug on again. See pictures.

Symbols on adjustment plug

S	= unleaded or leaded premium fuel
N =	= unleaded or leaded regular fuel
EZ ECES	= operation without lambda closed-loop control
EZL KAT	= operation with lambda closed-loop control

This adjustment to PREMIUM or REGULAR FUEL may also be performed by the customer.



Adjustment plug position "S"

Note:
The optimum performance and consumption values are obtained when operating with PREMIUM FUEL.
If a switch is made from PREMIUM to REGULAR FUEL, it is absolutely necessary to adapt the ignition timing (danger of engine damage). The ignition timing must also be adapted if a change is made from REGULAR to PREMIUM FUEL.

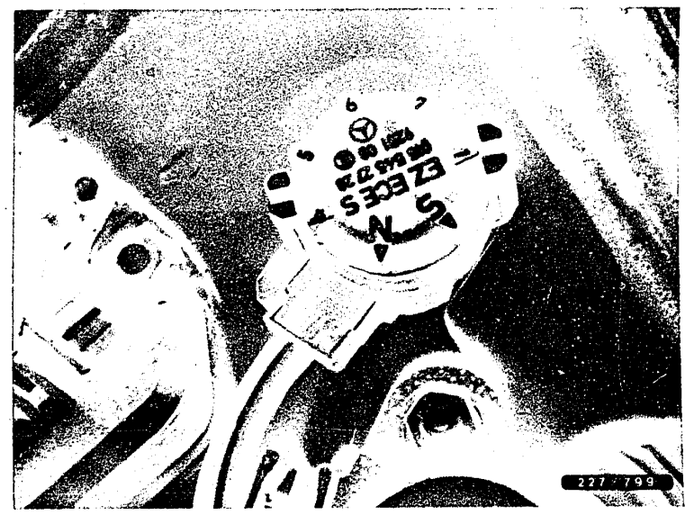
2. IGNITION TIMING adjustment in vehicle WITHOUT CATALYTIC CONVERTER

2.1 Ignition timing for leaded and unleaded PREMIUM FUEL

ADJUSTMENT PLUG with inscription EZ ECES
(code color white) in POSITION "S". See top picture.

Adjustment plug position "1"

Correction position for the workshop
In order to obtain maximum engine power, position "1" may be used if operating on leaded premium fuel RON 98.
See bottom picture. Ignition timing is ADVANCED by 2°.



2.2 Ignition timing for leaded and unleaded REGULAR FUEL
ADJUSTMENT PLUG with inscription EZ ECES (code color white) in position "N". See top picture.

3. IGNITION TIMING setting for vehicle WITH CATALYTIC CONVERTER

3.1 Ignition timing for unleaded PREMIUM FUEL
ADJUSTMENT PLUG with inscription EZL KAT (code color green) in position "S". See bottom picture.

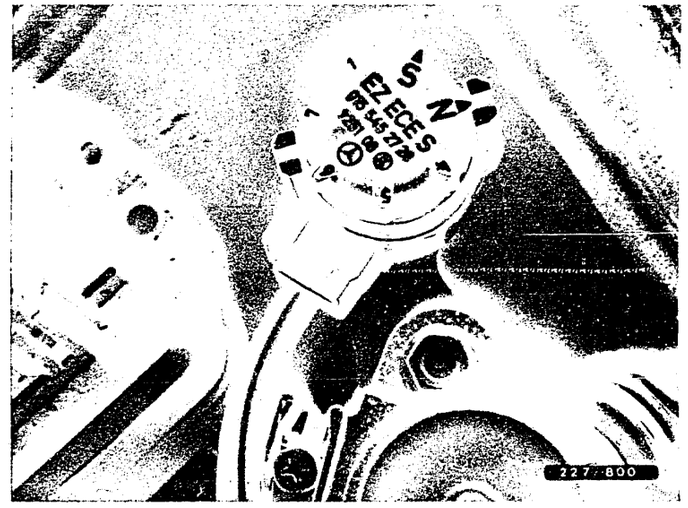
Correction position for the workshop

In the case of poor-quality premium fuel, adjustment plug (see bottom picture) in position "5".
Ignition timing is RETARDED by 2°.

3.2 Ignition timing for unleaded REGULAR FUEL
ADJUSTMENT PLUG with inscription EZL KAT (code color green) in position "N". Position "N" not shown.

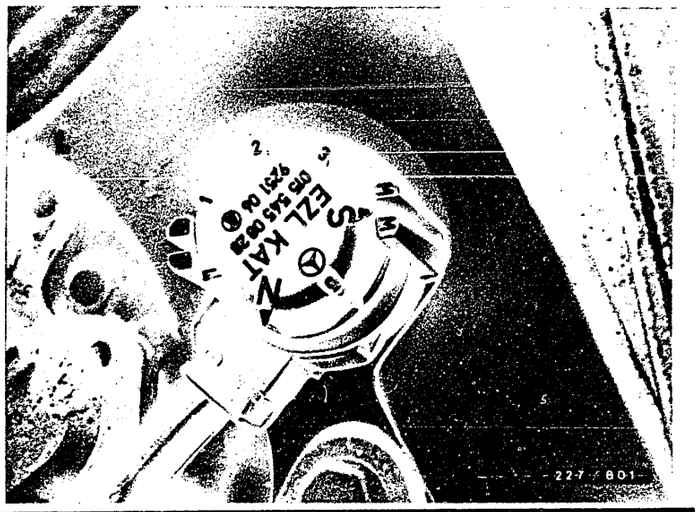
Correction position for the workshop
In the case of poor-quality regular fuel, adjustment plug in position "7". Position "7" not shown. Ignition timing is RETARDED by 2°.

Note: In vehicle with automatic transmission, do not use adjustment-plug position "7" because this signal is used for the transmission overload protection.



Adjustment plug position "N"

Adjustment plug position "S"



9. Trouble-shooting

9.1 How to use the trouble-shooting chart

The trouble-shooting chart starting on Coordinate G 3 contains customer complaint (fault symptom), cause of trouble, test instructions and coordinate references.

The possible cause of the fault should be selected from the trouble-shooting chart in accordance with the customer complaint (fault symptom).

If the cause of the fault is not clear, start testing with the detailed, self-contained trouble-shooting program beginning on Coordinate G 9.

If the cause of the fault is clear from the trouble-shooting chart, direct trouble-shooting is possible by going to the stated coordinate without having to perform the entire trouble-shooting program for each fault.
If there is no coordinate reference, trouble-shooting must be performed in accordance with the "Test instructions" column.

9.2 Procedure - trouble-shooting program

The trouble-shooting program starting on Coordinate G 9 is divided into 3 rows of boxes.

The left-hand row contains test instructions and test specifications.

The center row contains repair instructions.

The right-hand row contains the illustrations/terminal diagrams belonging to the text and the explanations of the items in the picture.

If the questions asked in the left-hand row can be answered conclusively with "yes", then proceed to the next test down.

If the answer to the question is "no", branch to the center row and carry out the tests given there.

9.3 Before testing, make sure of the following:

Battery fully charged, fuel system O.K., engine mechanically O.K. (e. g. compression, valve clearance etc.). Ambient temperature/ignition system temperature 0^{o} to 100^{o} C (temperature has a considerable effect on measured values).

9.4 Trouble-shooting chart

Customer complaint (fault symptom)

1. Starting motor operates, but engine fails to start
2. Rough idling
3. Poor throttle response
4. Engine lacks power
5. Misfiring
6. Fuel consumption too high
7. Engine pings when accelerating
8. Backfiring
9. Engine becomes too hot

1	2	3	4	5	6	7	8	9	Cause of fault	Test instructions	Coordinates
●	●	●	●	●	●	●	●	●	Unclear	Perform detailed trouble-shooting	G 9
●	●	●	●	●	●	●	●		Spark plugs defective	Assessment by means of ignition oscilloscope or visual examination of spark plug when removed	----
●	●	●	●	●					Shunt on secondary side	Evaluation of the ignition coil, high voltage distributor, ignition harness, and spark plug by means of the ignition oscillogram or a visual inspection	----
●	●	●	●	●					Open circuit on secondary side	Assessment of ignition coil, ignition distributor, ignition harness and spark plug by means of ignition oscilloscope, or continuity test with ohmmeter	----
●	●	●	●	●					Ignition coil defective	-	G 11
		●	●	●	●				Interference-suppression resistors defective	Assessment by means of ignition oscilloscope or resistance measurement	----

Trouble-shooting chart (continued)
Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start	2. Rough idle	3. Poor throttle take-up (flat spot on acceleration)	4. Insufficient engine power	5. Misfiring	6. Fuel consumption too high	7. Engine pinging when accelerating	8. Backfiring	9. Engine overheating	Cause of trouble	Test instructions	Coordinates
•							•		Firing sequence incorrect	See Autodata test specifications	-----
•		•		•			•		High-voltage distributor setting incorrect	---	G 13
•									Contact resistance or EI control unit not O.K.	---	G 15
		•							Vehicles with automatic transmission only Transmission overload protection defective	---	G 17...G 19
			•		•	•		•	Pressure sensor defective	---	G 21
			•		•				Coolant-temperature sensor defective	---	G 23
			•		•	•			Spark advance incorrect	To avoid incorrect measurements, be sure to perform testing as given on coordinates.	G 17...H 3
						•			Intake-air temperature sensor defective	---	H 7
			•		•	•		•	Throttle-valve switch (idle contact) defective	---	H 9

Trouble-shooting chart (continued)

Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start	2. Rough idle	3. Poor throttle take-up (flat spot on acceleration)	4. Insufficient engine power	5. Misfiring	6. Fuel consumption too high	7. Engine pinging when accelerating	8. Backfiring	9. Engine overheating	Cause of trouble	Test instructions	Coordinates
				•					EZ control unit/ignition coil power supply defective (engine idling)	---	H 11
•									Peak-coil-current cutoff defective	---	H 13
				•					Primary voltage (EZ control unit) incorrect	---	H 15
•									Pulse-generator insulation, internal resistance, voltage incorrect	---	H 17...H 19
•									EZ control unit power supply incorrect (ignition ON)	---	H 21
•									Primary-circuit power supply incorrect (ignition ON)	---	H 21

9.5 Detailed trouble-shooting program

9.5.1 Trouble-shooting program if primary signal/ignition sparks present

Test primary signal. If no oscilloscope or tachometer available, check whether ignition spark across spark gap.
Remove the protective cap from the ignition coil.

Primary signal testing with oscilloscope
Connect oscilloscope to ignition coil as per operating instructions.
Start engine.
Oscilloscope must indicate a primary voltage (of any value).

Primary signal testing with tachometer
Connect tachometer to ignition coil as per operating instructions.
Start engine.
Tachometer must indicate a reading (of any value).

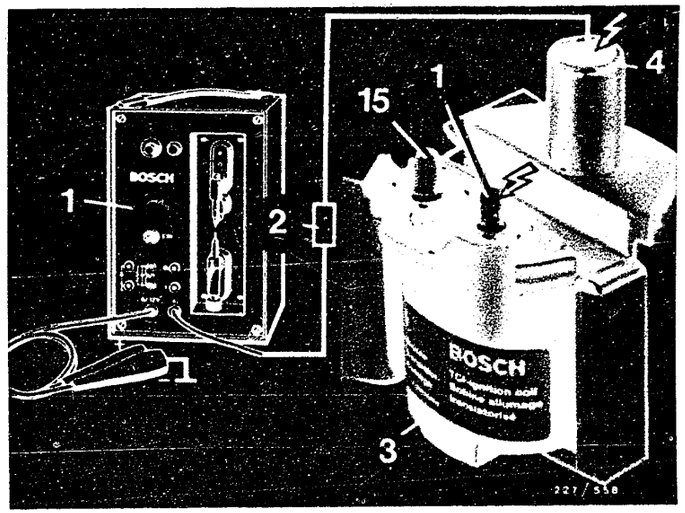
Ignition spark testing with spark gap
Remove H.T. ignition cable terminal 4 from ignition coil.
Connect spark gap including sleeve-type suppressor (5 kΩ) to ignition coil.
Adjust spark gap to 5 mm.
Start engine.
There must be sparks across the spark gap.
Primary signal present or ignition sparks across spark gap?

no → If no primary signal or no ignition spark, continue testing at H17.

Tests from G11 onwards not necessary.

yes ↓

Continued on G11/G12



High voltage arrows:
Warning, 400 V ... 25 kV!

1 = Spark gap
2 = 5 kΩ sleeve-type suppressor
3 = ignition coil

yes

Check distributor cap, distributor rotor, H.T. ignition cables and spark plugs.

High-tension side O.K.?

no → Repair high-tension side.

yes

Check the ignition coil.

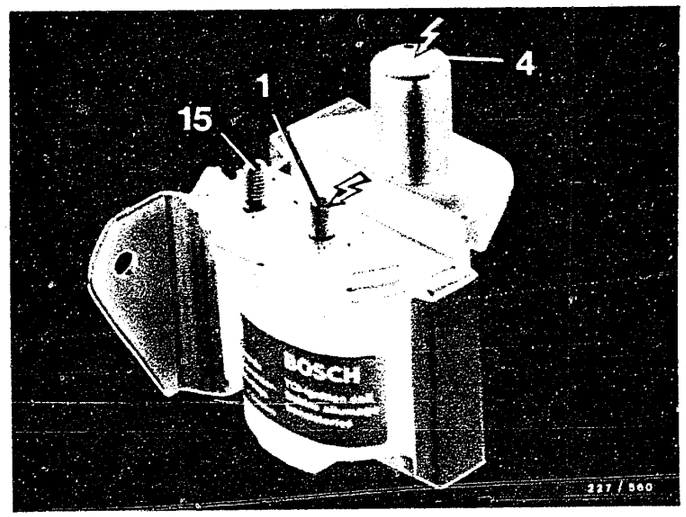
Remove the protective cap from the ignition coil.
Primary ignition coil (Term. 15 and 1)
0.30...0.60Ω (Take resistance of measuring lead and test prods into consideration.)
Secondary ignition coil (Term. 1 and 4)
7.3...13.2 kΩ.

Are values for resistance O.K.?

no → Replace ignition coil.

yes

Continued on G13/G14



High voltage arrows:
Warning, 400 V ... 25 kV!

yes

Engine running?

no

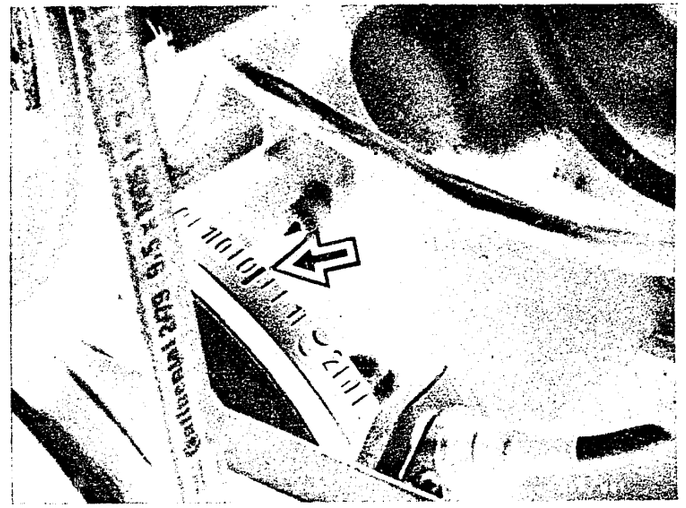
1st test step

Remove the cap and the dust protector cover from the high voltage distributor.

Set Cylinder 1 at the TDC marking. For the marking, see the Figure at the top.

The distributor rotor must be positioned such that the center of the distributor rotor electrode points toward the mark on the housing for cylinder 1.
See arrows in bottom picture.

Adjust the high voltage distributor.

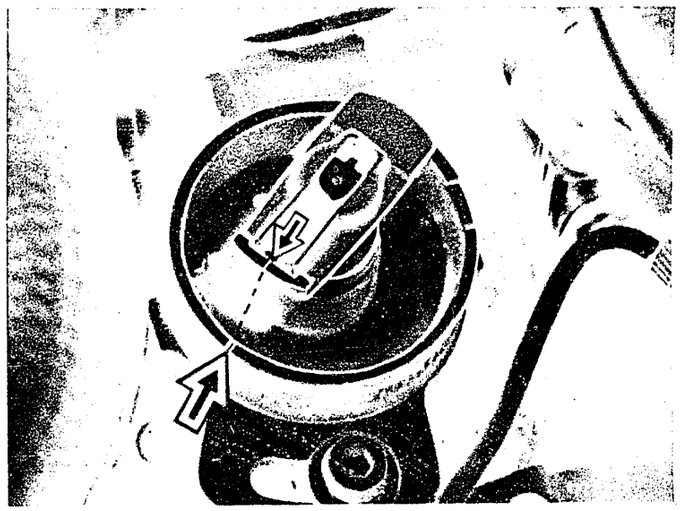


Arrow=TDC marking

yes

Continued on G17/G18

Continued on G15/G16



continued

2nd test step

Disconnect the negative and positive leads from the battery.

Disconnect the electronic ignition control unit plug. Switch the ignition on.

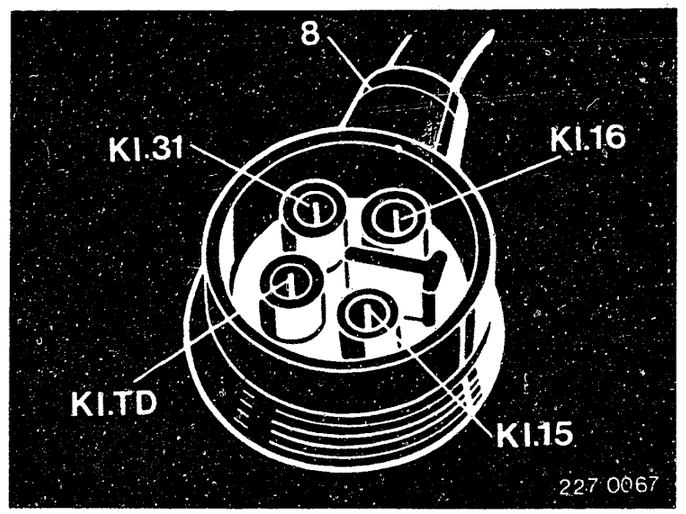
1. Check the leads from the positive battery terminal to the electronic ignition control unit plug Term. 15 and the leads from the negative battery terminal to the electronic ignition control unit plug Term. 31 for contact resistances. Max. total contact resistance 0.3Ω. (Take resistance of measuring lead into consideration.) Eliminate contact resistances.

2. Check the leads from the positive battery terminal to the ignition coil Term. 15 and the lead from the ignition coil Term. 1 to the electronic ignition control unit plug Term. 16 for contact resistance. Max. total contact resistance 0.3 Ω. (Take the resistance of the measuring lead into consideration.) Eliminate any contact resistance.

3. If test steps 1 and 2 O.K., try installing specified ignition coil. If engine still not running, re-install "old" ignition coil and replace EZ control unit.

yes

Continued on G17/G18



8=Electronic ignition control unit plug
Kl.=Term.

yes

Check transmission overload protection.
Vehicles with automatic transmission only.
1. Loosen union nut on transmission overload-protection switch and disconnect connector.
See arrow in top picture.
Connect ohmmeter to transmission overload-protection switch. See bottom picture.
Operate engine at idle.

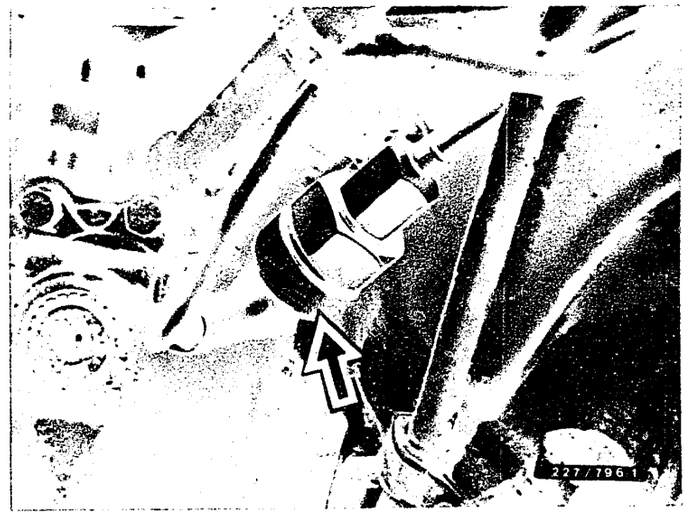
Pull on handbrake, lay chocks under rear wheels.

See table for resistance values for respective selector-lever position:

Driving position	Resistance
"N" or "P"	= > 20 kΩ
"D"	= < 1 Ω

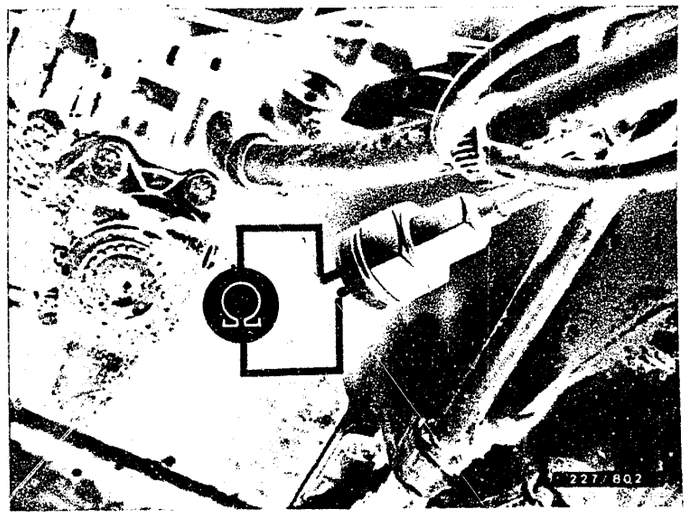
Resistance values O.K.?

no → Replace transmission overload-protection switch. Repeat test. If resistance values still not obtained, repair transmission (DB dealer).



yes

Continued on G19/G20



Continued

2. Read off adjustment-plug position and note down.
Pull out adjustment plug as far as it will go, bring into position "1" and plug on again. See top picture.

Switch off ignition.
EZ control-unit plugs connected.
Connect voltmeter to disconnected connector of transmission overload-protection plug.
See bottom picture.
Switch on ignition.
Voltmeter must indicate approx. 5 V.
Voltage correct?

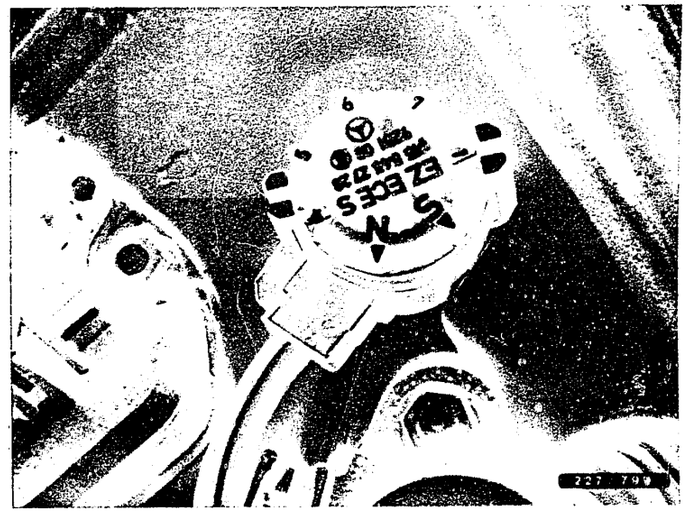
no → Check for open circuit on positive and negative sides.
Eliminate open circuit.
If there was no open circuit, replace EZ control unit.

yes

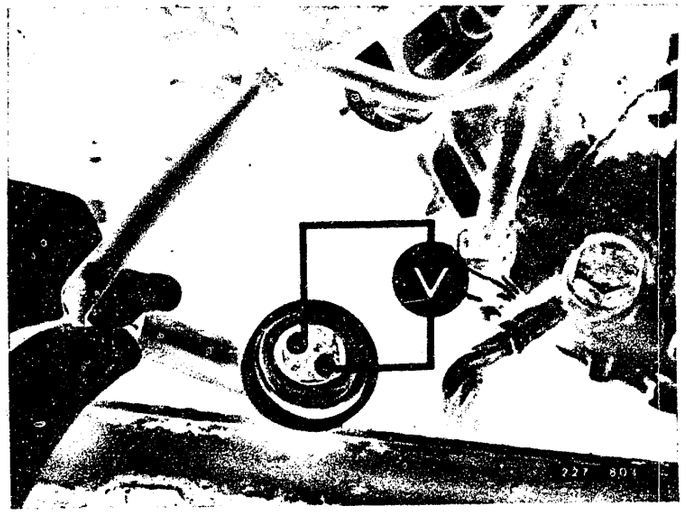
Re-establish original position of adjustment plug.

yes

Continued on G21/G22



Adjustment plug position "1"
(e.g. for EZ ECES)



yes

Check the pressure sensor

Connect the motortester to the diagnosis socket using an adapter cable. Disconnect the vacuum hose from the electronic ignition control unit. See the Figure at the top.

Take the plug connection from the throttle valve switch apart. See the Figure at the bottom. Run the engine at idle.

Take reading for timing angle.

Put the vacuum hose back on the electronic ignition control unit. When this is done, the timing angle must change noticeably (in the direction "advance").

Did the timing angle change?

no

1. Check the vacuum hose from the electronic ignition control unit to the intake manifold plug connection for leaks. Eliminate any leaks.

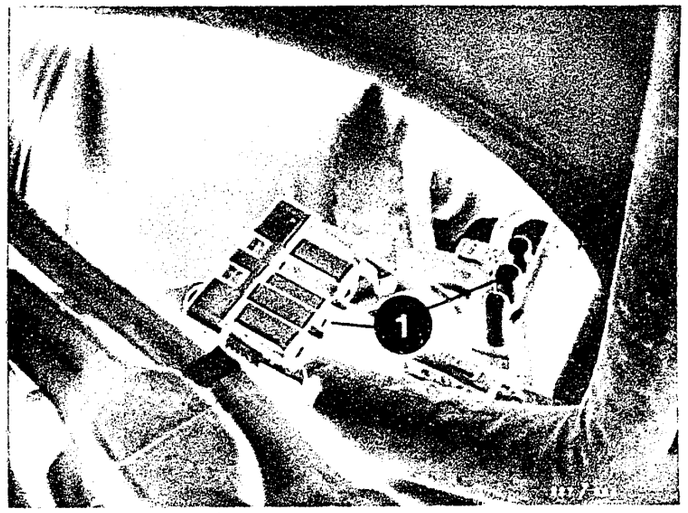
2. If there was no leak, take out and replace the electronic ignition control unit.



1=Diagnosis socket
2=Vacuum hose

yes

Continued on G23/G24



1=Plug connection from the throttle valve switch

yes

Check the coolant temperature sensor.

Warm the engine up to normal operating temperature.
Connect the motortester to the diagnosis socket using an adapter lead.
Disconnect the vacuum hose at the electronic ignition control unit. Disconnect the intake air temperature sensor plug. See the Figure at the top.
Run the engine at 3200 min^{-1}. Take reading for timing angle.
Disconnect the coolant temperature sensor plug (color of cable green/black). See Figure at the center.
When this is done, the timing angle must change.

Did the timing angle change?

yes

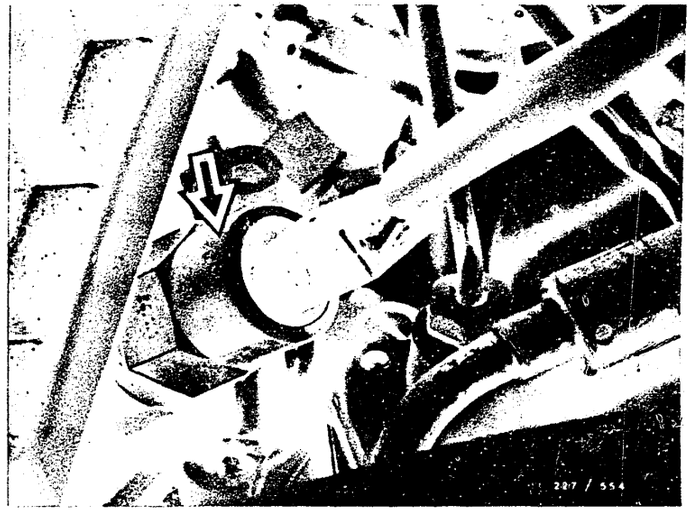
Continued on H1/H2

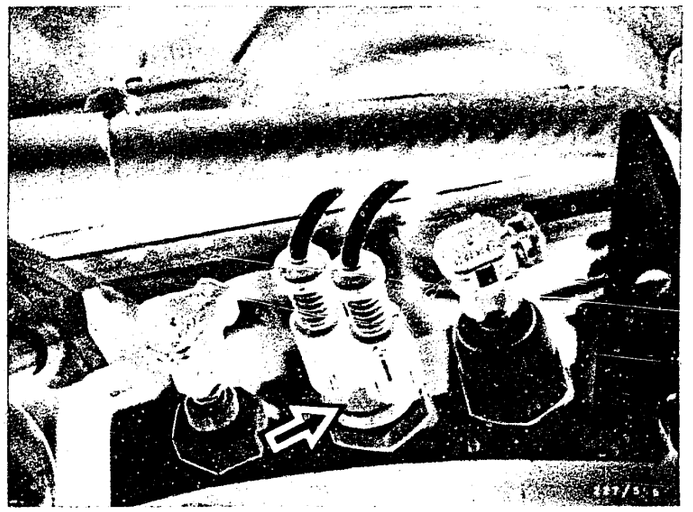
no

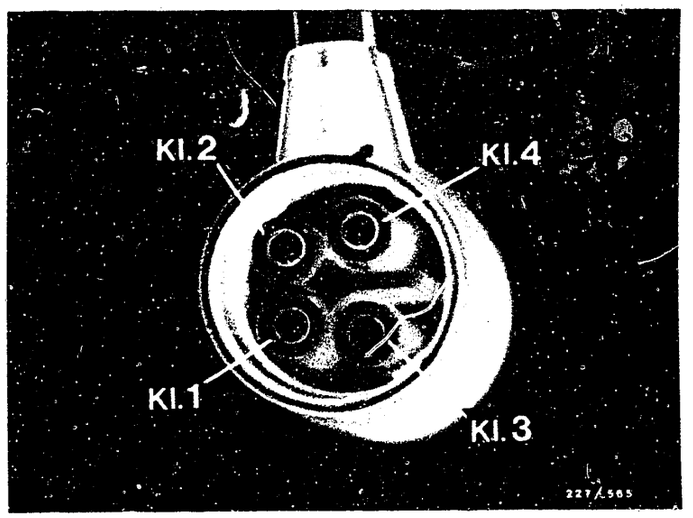
Switch the ignition off.
Disconnect the electronic ignition control plug and connect an ohmmeter to Term. 1 (Figure at bottom) and vehicle ground.
For resistances, see the table.

Coolant temperature		Resistance
+ 20°C	=	2.1...2.9 kΩ
+ 30°C	=	1.4...2.0 kΩ
+ 80°C	=	280...370 Ω
+ 90°C	=	210...280 Ω
+100°C	=	160...215 Ω

If the ohmmeter reads ∞Ω, then check the lead from the coolant temperature sensor plug (color of cable green/black) to the electronic ignition control unit plug Term. 1 for continuity. Eliminate any break. If the values for resistance deviate, take out and replace the coolant temperature sensor.







yes

Check spark advance.
Engine at operating temperature. Connect motortester with adapter lead to diagnostic socket. See center picture, Item 1.
Disconnect intake-air temperature sensor plug. See top picture, arrow.
Disconnect vacuum hose from EZ control unit. See center picture, Item 2. Disconnect plug connector from throttle-valve switch. See bottom picture, Item 1.

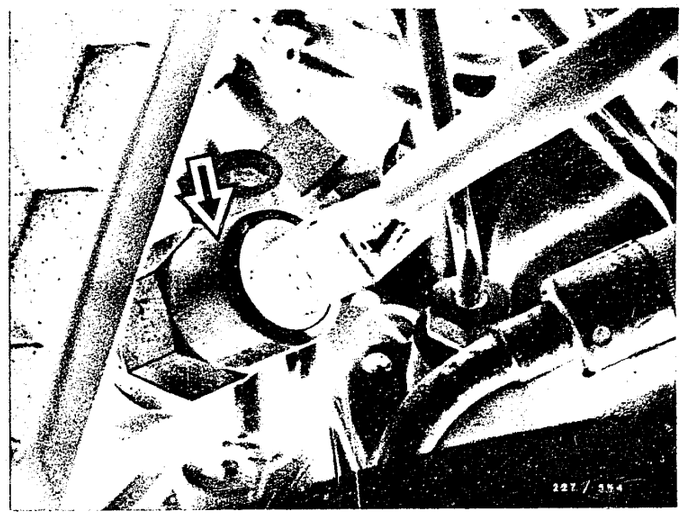
Spark advance should be for:

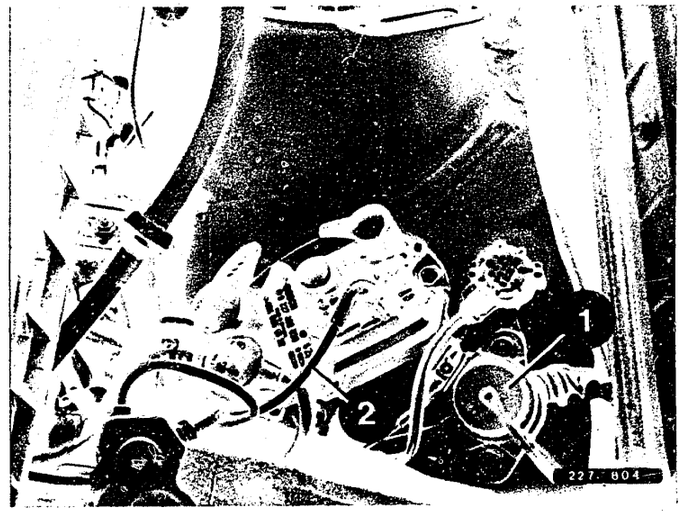
Vehicles WITH catalytic converter

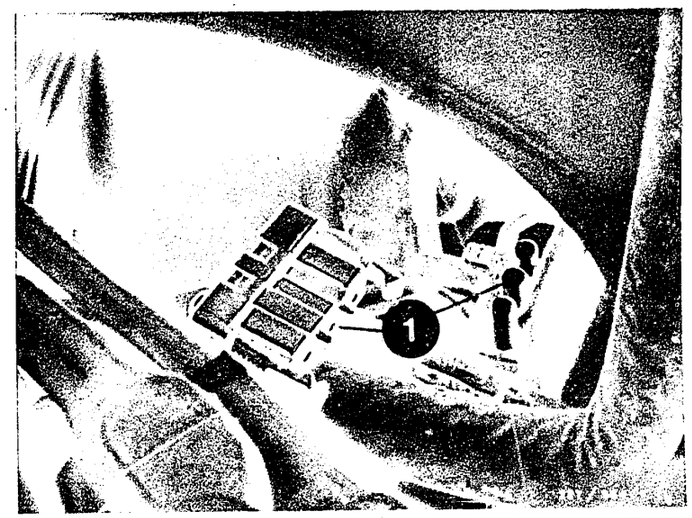
Fuel	Adjustment plug EZL KAT (green)	Speed min^{-1} or °crankshaft BTDC
Premium unleaded	Position S	4000 18–22°
Regular unleaded	Position N	4000 13–17°

yes

Continued on H3/H4







Continued

Vehicles WITHOUT catalytic converter

Fuel	Adjustment plug EZ ECES (white)	Speed min^{-1} /°crankshaft BTDC
Premium unleaded /leaded	Position S	4000 18–22°
Regular unleaded /leaded	Position N	4000 13–17°

Spark advance as per table O.K.?

yes

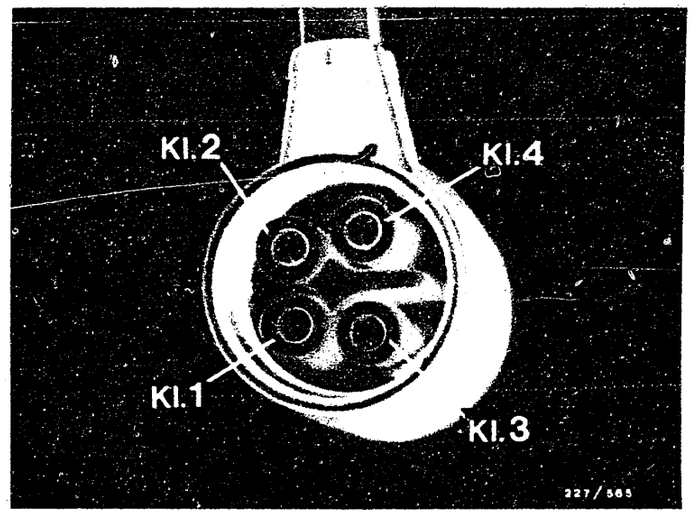
Continued on H7/H8

no

Switch off ignition.
Disconnect EZ control-unit plug.
See top picture. Connect ohmmeter to term. 3 and vehicle ground.
Turn adjustment plug, in turn, from position 1 or S to 7. See table for resistance values.
Note: The resistance network of both adjustment plugs is identical. The adjustment plugs differ only by the imprint EZ ECES (white)/ EZL KAT (green).
See bottom picture.

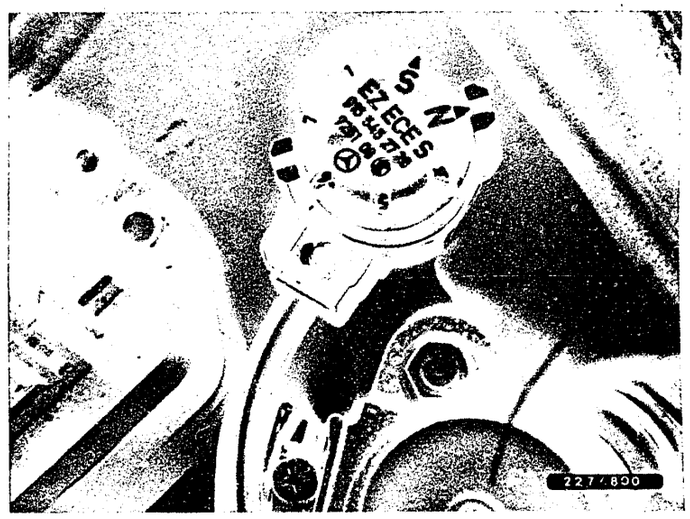
Adjustment-plug position	Resistance values
EZ ECES	EZL KAT
S	1 = ∞Ω
2	2 = 2.4 kΩ
N	3 = 1.3 kΩ
4	S = 750 Ω
5	5 = 470 Ω
6	N = 220 Ω
7	7 = 0 Ω

Continued on H5/H6



EZ = Control-unit plug

Adjustment plug
(e.g. EZ ECES)

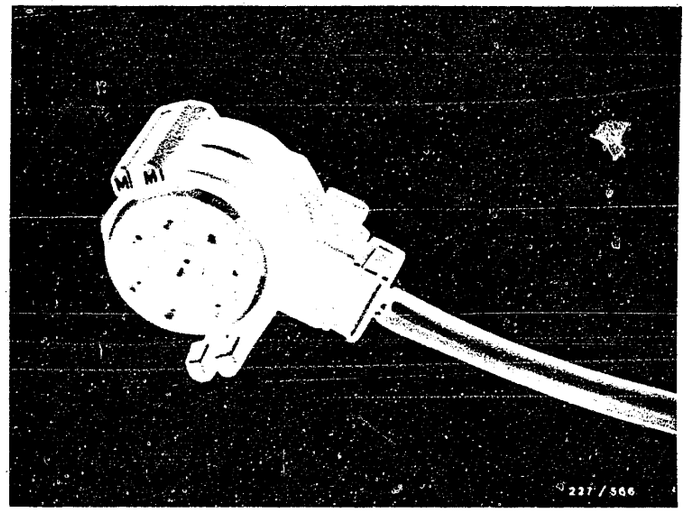


Continued

If resistance was O.K. in all adjustment-plug positions, replace EZ control unit.

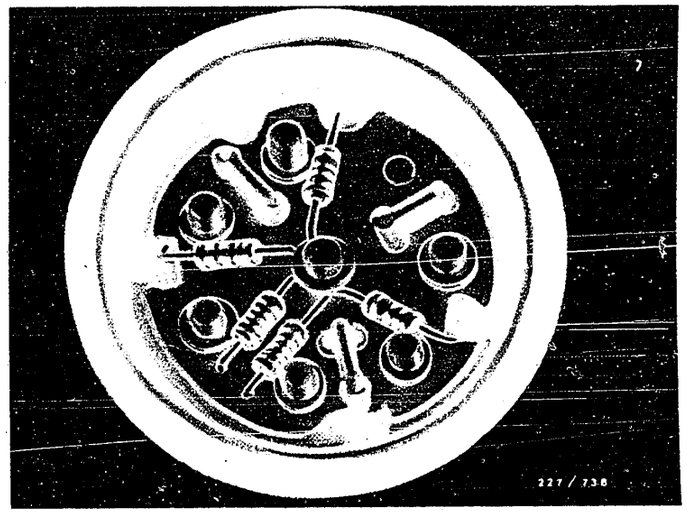
If resistance was approx. 0 Ω or ∞Ω in all adjustment-plug positions, replace adjustment-plug housing without adjustment plug.
See top picture.

If resistance was not within tolerance, replace adjustment plug.
See bottom picture.



Adjustment-plug housing

yes



Adjustment plug (from rear)

Continued on H7/H8

yes

Check the intake air temperature sensor.
1. Switch the ignition off.
Remove the top portion of the air filter.
Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 4 (-) and battery terminal (+).
See the Figure at the top. Switch the ignition on.
Carefully heat the intake air temperature sensor with a suitable source of heat (e.g. a soldering gun, a hair-dryer), to > + 25°C. See Figure at center.
The voltmeter must read approx. 0 V.

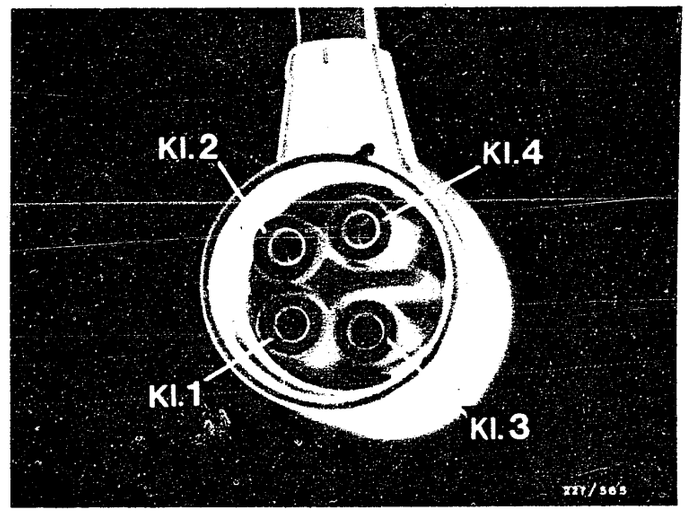
2. Cool the intake air temperature sensor to < + 25°C (e.g. with a refrigerant spray).
The voltmeter must read approx. battery voltage. Are the voltages in points 1 and 2 O.K.?

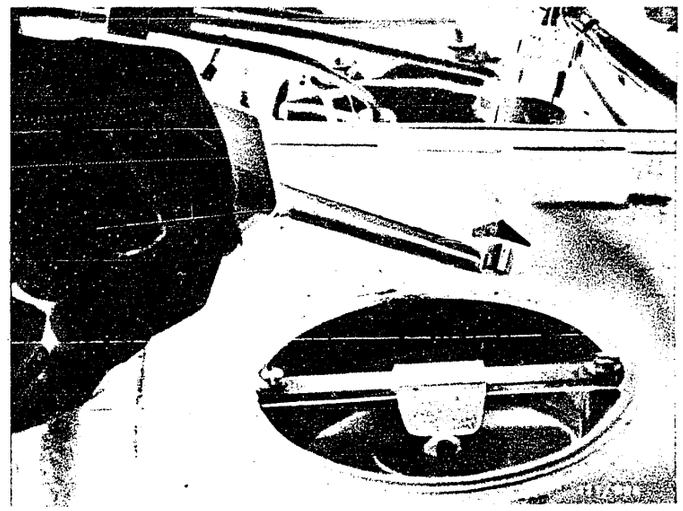
no

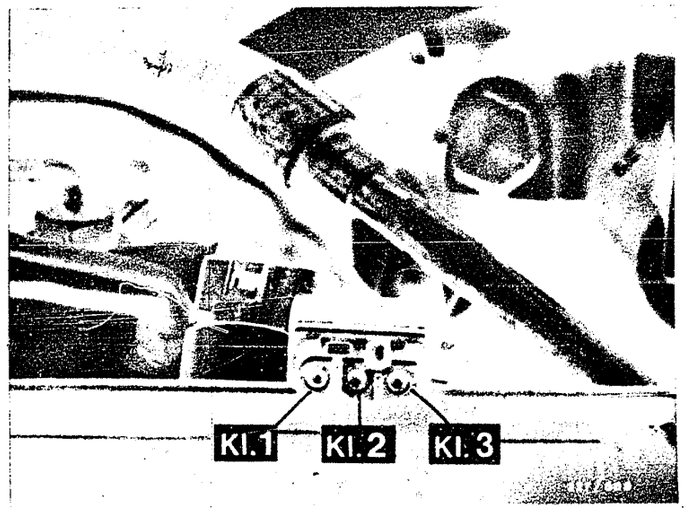
Disconnect the intake air temperature sensor plug. See the Figure at the bottom. Check the lead from Term. 1 (+) and Term. 3 (-) from the intake air temperature sensor and the lead from Term. 2 from the intake air temperature sensor to the electronic ignition control unit plug Term. 4 for a break. Eliminate any break. If there was no break present, take out and replace the intake air temperature sensor.

yes

Continued on H9/H10







yes

Check the idle contact in the throttle valve switch.
Switch the ignition off.
Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 2 and vehicle ground. The throttle valve is in the idle setting. The resistance measured must be approx. 0 Ω (continuity). Open the throttle valve. The ohmmeter must read ∞ Ω.

Are the values for resistance O.K.?

no

1. Disconnect the plug connection from the throttle valve switch. See the Figure at the center. Connect an ohmmeter one after the other to:

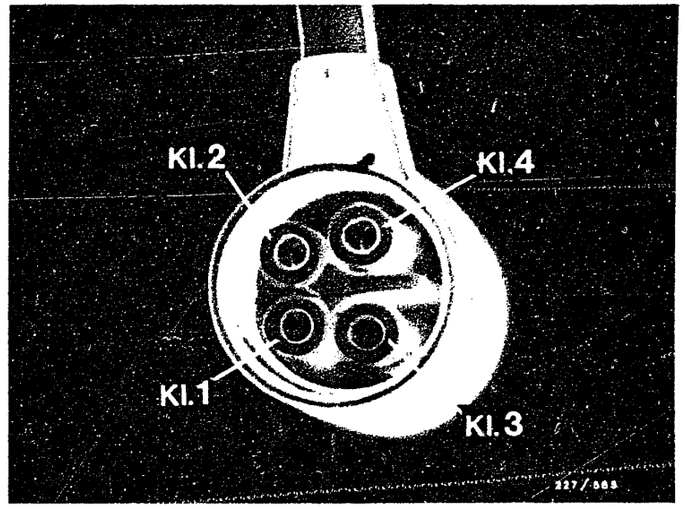
Throttle valve switch plug connection		Electronic ignition control unit plug
Term. 1	and	Term. 2
Term. 2	and	vehicle ground

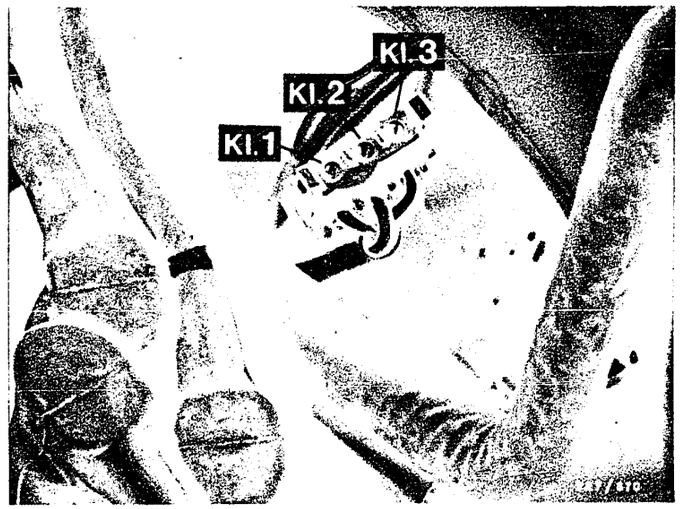
The ohmmeter must read approx. 0Ω (continuity). Eliminate any break.

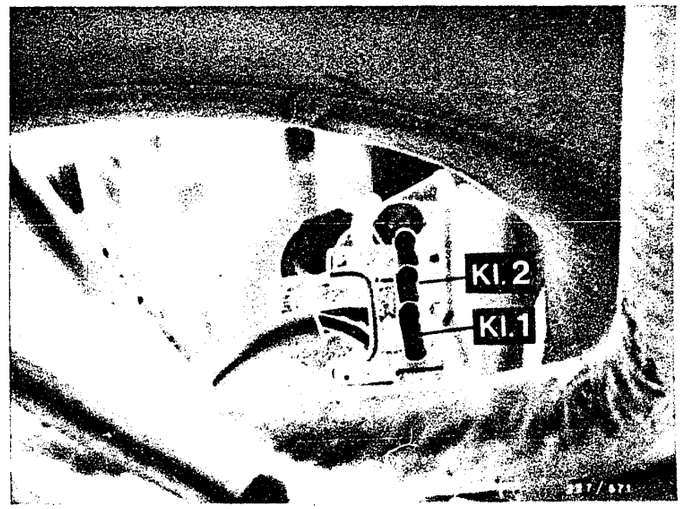
2. Connect the ohmmeter to the throttle valve switch plug connection Term. 1 and Term. 2. See the Figure at the bottom. The throttle valve is closed.
Resistance approx. 0 Ω

Open the throttle valve. The ohmmeter must read ∞Ω.

If resistance not O.K., replace throttle-valve switch.







yes

Continued on H11/H12

yes

Check the voltage supply to the electronic ignition control unit and the ignition coil.

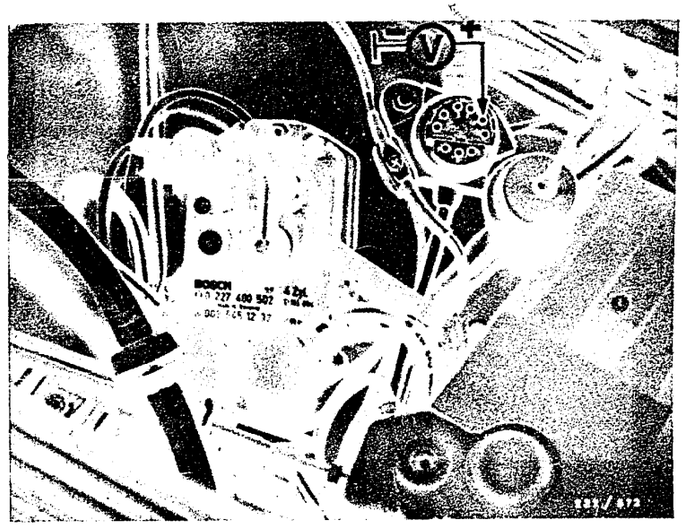
Connect the voltmeter and test prod to the diagnosis socket Term. 5 (+) and the battery terminal (-). See the Figure.
Run the engine at idle.
The voltage measured must be 12 ... 14 V and must not be more than 1 V less than battery voltage.

Is the value for voltage O.K.?

no

Disconnect the positive lead from the battery. Switch the ignition on. Check the leads from the positive battery terminal to the ignition coil Term. 15 for contact resistance.
Max. contact resistance 0.3 Ω.
(Take the resistance of the measuring lead and the test prods into consideration.)

Eliminate any contact resistance.



Diagnosis socket

yes

Continued on H13/H14

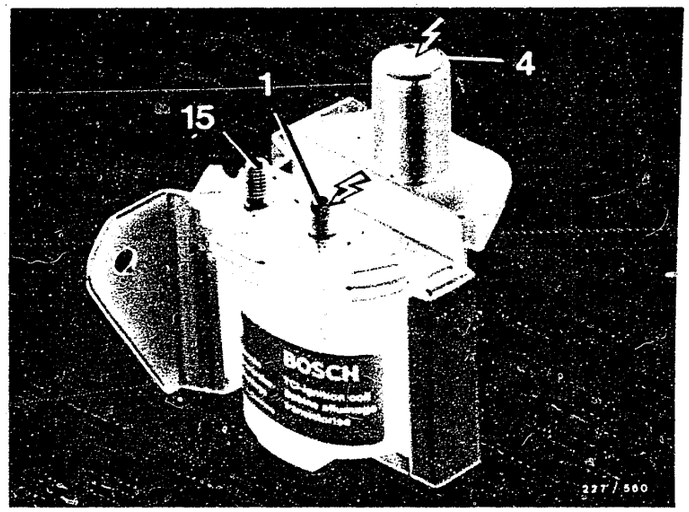
yes

Check the peak coil current cutoff
Connect a voltmeter to the ignition coil Term. 15 and Term. 1. Switch the ignition on. For approx. 1 sec. the voltmeter can move a short distance.
The voltmeter must return to 0 V.
Is the value for voltage (0 V) O.K.?

no → Take out and replace the electronic ignition control unit and the ignition coil.

yes

Continued on H15/H16



High voltage arrows:
Warning, 400 V...25 kV!

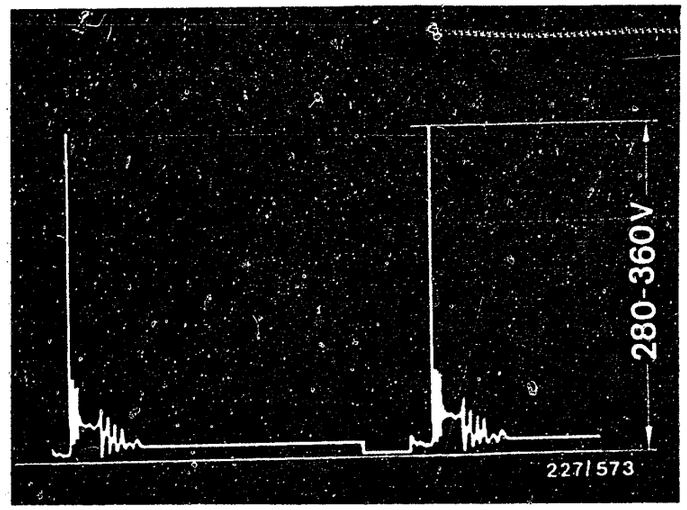
yes

Check primary voltage.

(If MOT series available).
Connect oscilloscope (e.g. MOT 201) together with pulse shaper 1 684 463 154 to ignition coil as per operating instructions.
Note: Incorrect reading without pulse shaper. Operate engine at idle.
Measured primary voltage must be 280 ... 360 V.
See graph.

Voltage correct?

no → Replace EZ control unit.



yes

If all test steps O.K. and customer complaint still not remedied, try installing specified ignition coil. If customer complaint still not remedied, re-install "old" ignition coil.
Ignition system O.K.
Testing completed.
Tests starting on H17 not necessary.

Note:
Further possible faults on fuel system or engine not mechanically O.K.

9.5.2 Trouble-shooting program if no primary voltage or no ignition spark available.
(Continued from G9/G10)

yes

Check insulation of pulse generator.

Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 7 and the battery terminal (-). See the Figure at the top. The ohmmeter must read ∞ Ω . Is the value for resistance O.K.?

no → If the value for resistance is approx. 0 Ω, take out and replace the pulse generator. See the Figure at the bottom.

yes

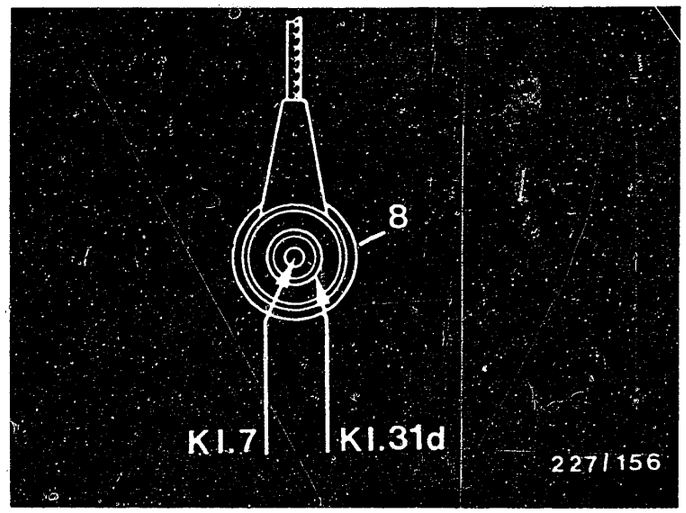
Check the internal resistance of the pulse generator.

Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 7 and Term. 31d. See the Figure at the top. The ohmmeter must read 680 ... 1200 Ω.
Is the value for resistance O.K.?

no → Take out and replace the pulse generator. See the Figure at the bottom.

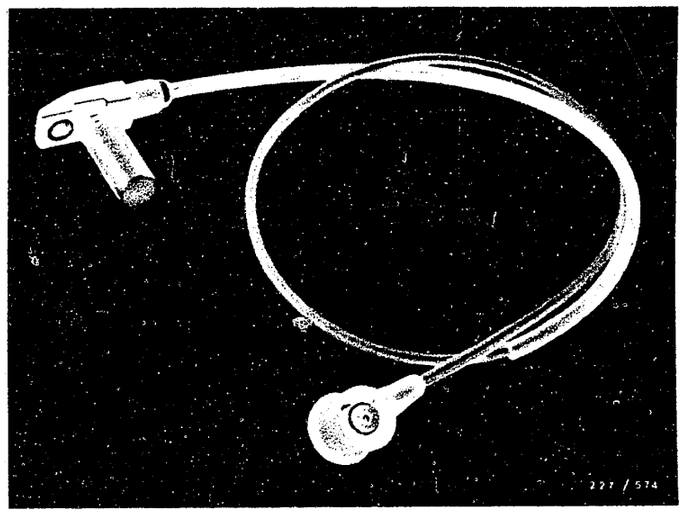
yes

Continued on H19/H20



8 = Electronic ignition control unit plug - pulse generator

Pulse generator

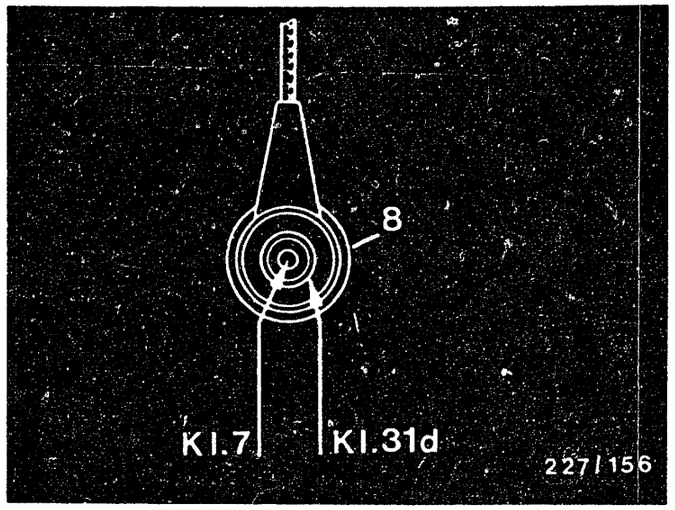


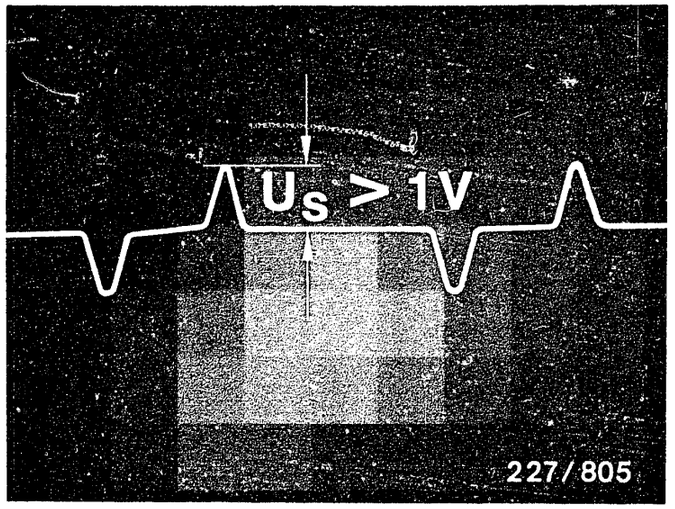
yes

Check pulse-generator voltage.
Connect oscilloscope as per operating instructions with program switch in "special" position.
For example, MOT 201:
Connect red and black clamps to disconnected EZ control-unit plug term. 7 (+) and term. 31d (-). See top picture.
Start engine.
Oscilloscope must indicate a voltage of at least 1 V.
See center diagram.
Voltage correct?

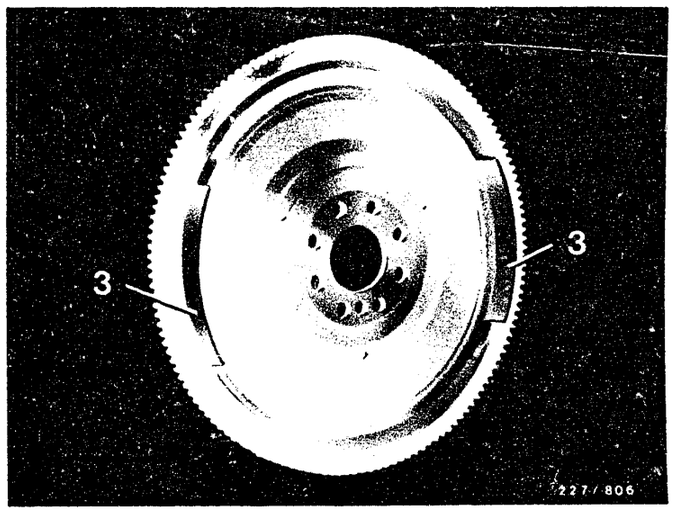
no →

Remove pulse generator and check for mechanical damage.
Using a suitable tool, turn over engine by hand, at the same time checking, through the pulse-generator bore, the 2 segments on clutch plate/
flywheel for mechanical damage. See bottom picture, Item 3.
Replace mechanically defective parts.
If pulse generator and segments mechanically O.K., replace pulse generator (electrically defective).





yes



Continued on H21/H22

yes

Check the voltage supply to the electronic ignition control unit.

Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 15 (+) and Term. 31 (-). See the Figure.
Switch the ignition on.
The voltmeter must show battery voltage.

Is the value for voltage O.K.?

no → Check the leads and connections from the ignition and starting switch to the electronic ignition control unit plug Term. 15, including the ground lead Term. 31, for a break. Eliminate any break.

yes

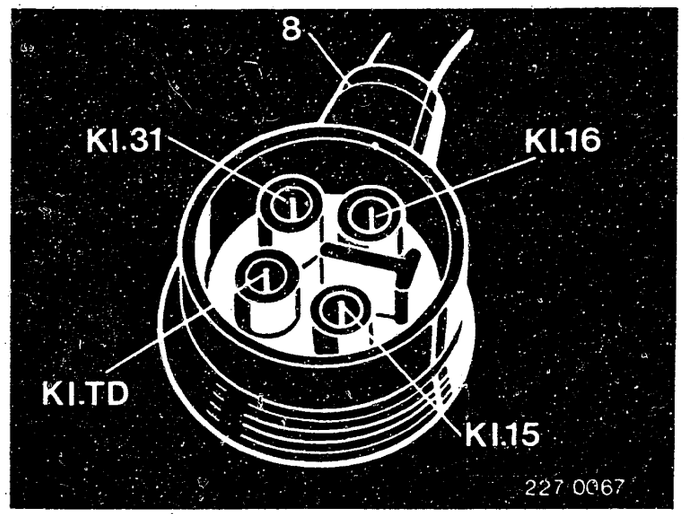
Check the primary circuit.
Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 16 (+) and Term. 31 (-). See the Figure.
Switch the ignition on.
The voltmeter must indicate battery voltage.

Is the value for voltage O.K.?

no → Check the supply lead from the ignition and starting switch to the ignition coil Term. 15, the primary winding of the ignition coil, and the lead from the ignition coil Term. 1 to the electronic ignition control unit plug Term. 16, including the ground lead, Term. 31, for a break. Eliminate any break.

yes

Continued on H23/H24



8=Electronic ignition control unit plug
Kl.=Term.

yes

Check ignition coil.

Remove protective cap from ignition coil.

Ignition coil, primary (term. 15 and term. 1)
0.30 ... 0.60 Ω (take resistance of test lead with test prods into account).
Ignition coil, secondary (term. 1 and term. 4)
7.3 ... 13.2 kΩ.

Resistance O.K.?

no → Replace ignition coil.

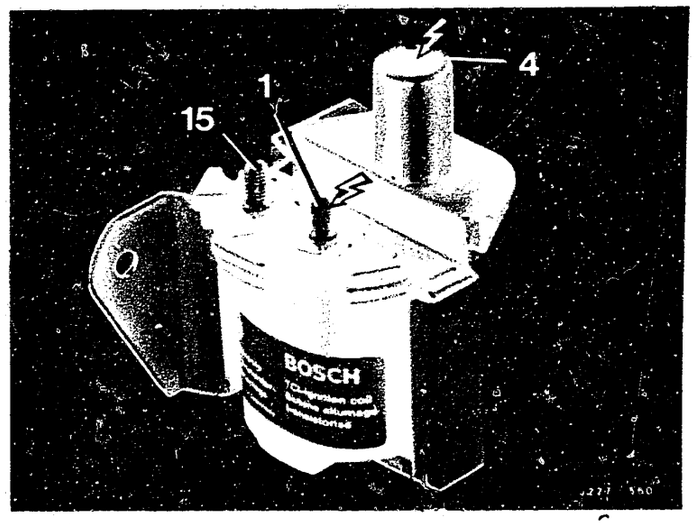
yes

If all test steps were O.K. and still no primary signal/ignition spark, try installing specified ignition coil.
If primary voltage/ignition spark still not present, re-install "old" ignition coil and replace EZ control unit.

Testing completed

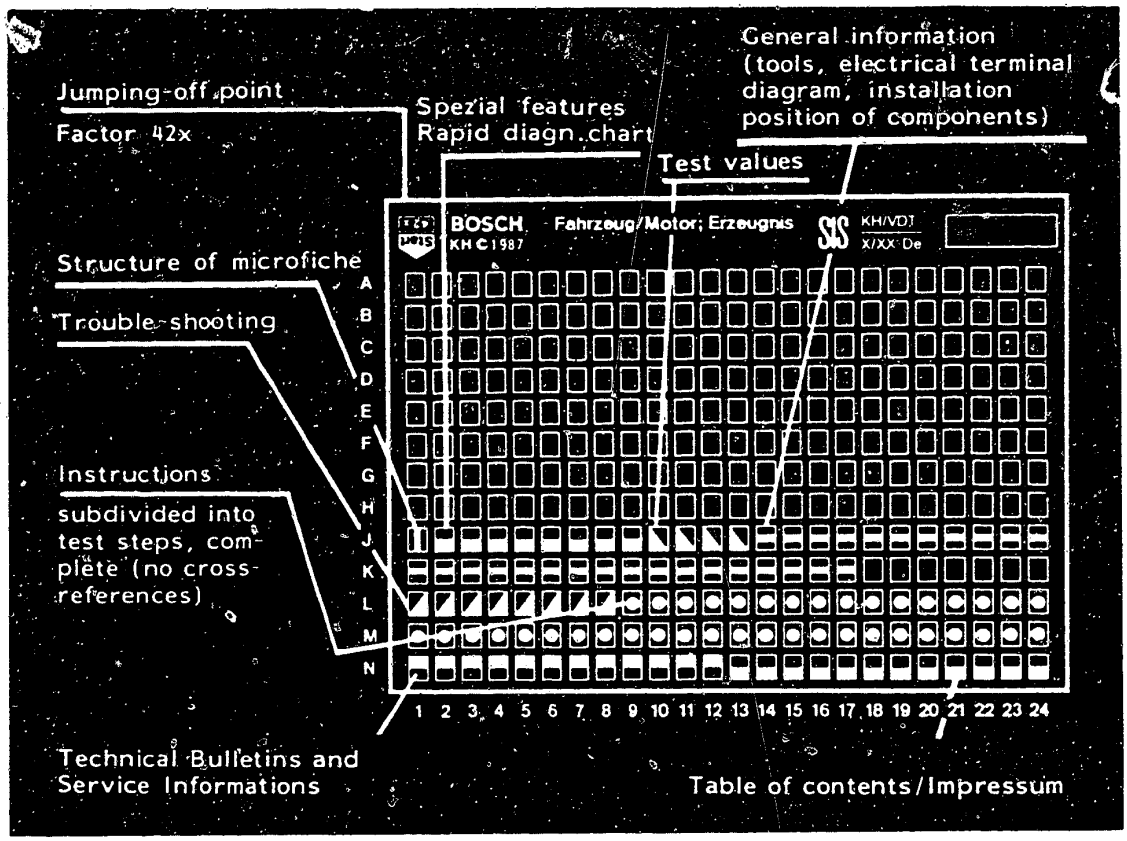
Tests from G11 not necessary.

Note:
If customer complaint still not remedied, further possible faults on fuel system, or engine not mechanically O.K.



Danger arrows:
Warning: 400V ... 25 kV

Structure of microfiche



1. Read from left to right

2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section

Beginning	Mid-section	End	One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6

C6

1. Special features

Mercedes Benz 560 SEL, SEC 117.968 ECE/CAT version (with transmission-overload protection and additional top-speed limitation on 220 kW engine).
Year of manufacture 1985, worldwide excluding USA, Japan, Australia

Equipped with:
EI control unit 0 227 400 6.. (with current limitation)
or
Siemens AG EI control unit (Daimler-Benz AG service part)
Note: Bosch and Siemens control units are interchangeable.
Ignition coil 0 221 5..

2. Rapid diagnosis chart

The rapid diagnosis chart starting on Coordinate J4 makes it possible for the experienced expert to quickly check the ignition system using the necessary testers and aids.

The rapid diagnosis chart consists of the test-step sequence, cause of trouble, test instructions, test specifications and coordinate details.

2.1 How to use the rapid diagnosis chart

The rapid diagnosis chart starting on Coordinate J4 must be used if a primary signal or ignition spark is available.

The rapid diagnosis chart starting on Coordinate J8 must be used if there is no primary signal or no ignition spark available.

If detailed information and instructions are required, always proceed in accordance with the trouble-shooting program starting on Coordinate L1.

Test requirement

Battery fully charged, fuel system O.K., engine mechanically O.K. (e.g. compression etc.).
Ambient temperature and temperature of the ignition system 0° to 100°C (temperature has great influence on the readings).

Before disconnecting any plug-in connections, make sure the ignition is switched off.

Rapid diagnosis chart Primary signal or ignition spark available

Test step	Possible cause of trouble	Test instruction	Test specifications	Coordinates
1	High-voltage side	Visual examination, e.g. of ignition harness, distributor cap etc., continuity test, ignition oscillogram.	---	L 11
2	Ignition coil	Resistance, primary term. 1 and term. 15 Resistance, secondary term. 1 and term. 4	0.2 ... 0.4 Ω 7.3 ... 13.2 kΩ	L 11
3	High-voltage-distributor adjustment	Cyl. 1 of engine at TDC. Center of distributor rotor points to marking on housing.	---	L 13
4*	Contact resistance	Test voltage-supply leads of EI control unit and primary circuit for contact resistance:	Max. 0.3 Ω	L 17
5	Transmission-overload protection	Engine at idle Resistance, transmission-overload-protection switch Automatic transmission, driving position "N" or "P" driving position "D" (observe SAFETY REGULATIONS).	> 20 kΩ < 1 kΩ	L 19
6	Pressure sensor	Disconnect vacuum hose from EI control unit. Run engine at 2000 min^{-1}. Read off spark-advance angle. Connect vacuum hose to EI control unit. Run engine at 2000 min^{-1}. Read off spark-advance angle.	Advance angle ADVANCED	L 23
7	Coolant-temperature sensor	Disconnect vacuum hose from EI control unit. Run engine (at normal operating temperature) at 2000 min^{-1}. Read off spark-advance angle. Disconnect both coolant-temperature-sensor plugs. Run engine at 2000 min^{-1}. Read off spark-advance angle. After testing, connect coolant-temperature-sensor plugs.	Spark-advance angle RETARDED	M 1
8	Spark-advance angle	Vehicle W I T H C A T A L Y T I C C O N V E R T E R . Disconnect vacuum hose from EI control unit. Disconnect plug-in connection from throttle-valve switch. Engine at normal operating temperature, but < 95°C.	Trimming-plug position "S" (PREMIUM FUEL) ** 24...28° before TDC at 3500 min^{-1}. Trimming-plug position "N" (regular fuel) ** 18...22° before TDC at 3500 min^{-1}	L 19 M 3

* Perform only when engine is not running.
** If test specifications not obtained, always test in accordance with coordinate details.

Test step	Possible cause of trouble	Test instruction	Test specifications	Coordinates
8a	Spark-advance angle	Vehicle W I T H O U T C A T A L Y T I C C O N V E R T E R Disconnect vacuum hose from EI control unit. Disconnect plug-in connection from throttle-valve switch. Engine at normal operating temperature, but < 95°C.	Trimming-plug position "S" (PREMIUM FUEL) ** 26...30° before TDC at 3500 min^{-1}. Trimming-plug position "N" (REGULAR FUEL) ** 20...24° before TDC at 3500 min^{-1}.	L 19 ↓ M 3
9	Throttle-valve-switch full-load contact and leads	Disconnect plug-in connection from throttle-valve switch. Resistance, throttle-valve-switch plug-in connection term. 2 and term. 3 (throttle-valve side). Throttle-valve idle position Throttle-valve full-throttle position Disconnect EI control-unit plug. Resistance, throttle-valve-switch plug-in connection term. 3 and term. 2 (wiring-harness side) to EI control-unit plug term. 2 or negative battery terminal.	∞Ω Approx. 0 Ω Approx. 0 Ω (continuity)	M 9
10	Voltage supply, EI control unit and ignition coil	Engine at idle Voltage, diagnostic socket term. 5 (+) and battery terminal (-)	12 ... 14 V Max. 1 V below batt. +ve	M 11
11	Peak-coil-current cutoff	Ignition ON Voltage, diagnostic socket term. 5 (+) and term. 4 (-)	After approx. 1 s. 0 V	M 13
12	EI control unit	Engine at idle Primary voltage, ignition coil term. 15 and term. 1	280 ... 360 V	M 15

** If test specifications not obtained, always test in accordance with coordinate details.

Rapid diagnosis chart No primary signal or ignition spark available

Test step	Possible cause of trouble	Test instructions	Test specifications	Coordinates
1	Pulse generator	Resistance, EI control-unit plug term. 7 and negative battery terminal (insulation test)	∞Ω	M 17
	Pulse generator	Resistance, EI control-unit plug term. 7 and term. 31d	680 ... 1200 Ω	M 17
	Pulse generator	Start engine. Voltage (oscilloscope), EI control-unit plug term. 7 (+) and term. 31d (-)	U_S > 1 v	M 19
2	Voltage supply, EI control unit	Ignition ON Voltage, EI control-unit plug term. 15 (+) and term. 31 (-)	Battery voltage	M 21
3	Voltage supply, primary circuit	Ignition ON Voltage, EI control-unit plug term. 16 (+) and term. 31 (-)	Battery voltage	M 21
4	Ignition coil	Resistance, primary term. 1 and term. 15 Resistance, secondary term. 1 and term. 4	0.2 ... 0.4 Ω 7.3 ... 13.2 kΩ	M 23

3. Test specifications

Ignition coil, primary	0.2 ... 0.4 Ω	L11
Igniton coil, secondary	7.3 ... 13.2 kΩ	
High-voltage distributor adjustment	Cyl. 1 at ign.-distrib. TDC marking	L13
Contact resistance, supply leads, EI control unit and primary circuit	Max. 0.3 Ω	L17
Transmission-overload-protection switch		L19
Driving position "N" or "P"	> 20 kΩ	
Driving position "D"	< 1Ω	

Coolant-temperature sensor	+ 20°C	2.1 ... 2.9 kΩ	M1
	+ 30°C	1.4 ... 2.0 kΩ	
	+ 80°C	280 ... 370 Ω	
	+ 90°C	210 ... 280 Ω	
	+ 100°C	160 ... 215 Ω	

Spark-advance angle without vacuum
Engine at normal operating temperature, but < approx. 95° C

Vehicles WITH catalytic converter

Fuel	Trimming plug EZL KAT (green)	Engine speed min^{-1} and ° crankshaft before TDC
Unleaded premium	Position S	3500 24 - 28 °
Unleaded regular	Position N	3500 18 - 28 °

Vehicles WITHOUT catalytic converter

Fuel	Trimming plug EZL ECE (white)	Engine speed min^{-1} and ° crankshaft before TDC
Unleaded/ leaded premium	Position S	3500 26 - 30 °
Unleaded/ leaded regular	Position N	3500 20 - 24 °

If test specifications not obtained, always test in accordance with coordinate details.

M5

Trimming-plug position
for version

EZL***	ECE*	CAT**
1	S	1 = ∞ Ω
2	2	2 = 2.4 kΩ
3	N	3 = 1,3 kΩ
4	4	S = 750 Ω
5	5	5 = 470 Ω
6	6	N = 220 Ω
7	7	7 = 0 Ω

* Color code: white
** Color code: green
*** Color code: white
(for 220 kW engine only)

M9

Throttle-valve-switch
full-load contact
Idle position ∞Ω
Full-throttle position approx. Ω

M11

Voltage supply, EI control unit and ignition coil with engine at idle	12...14 V Max. 1 V below batt. +ve

M13

Peak-coil-current cutoff
after approx. 1 s
with ignition ON 0 V

M15

Primary voltage
with engine at idle 280...360 V

M17

Insulation, pulse generator ∞Ω
Internal resistance
pulse generator 680...1200 Ω

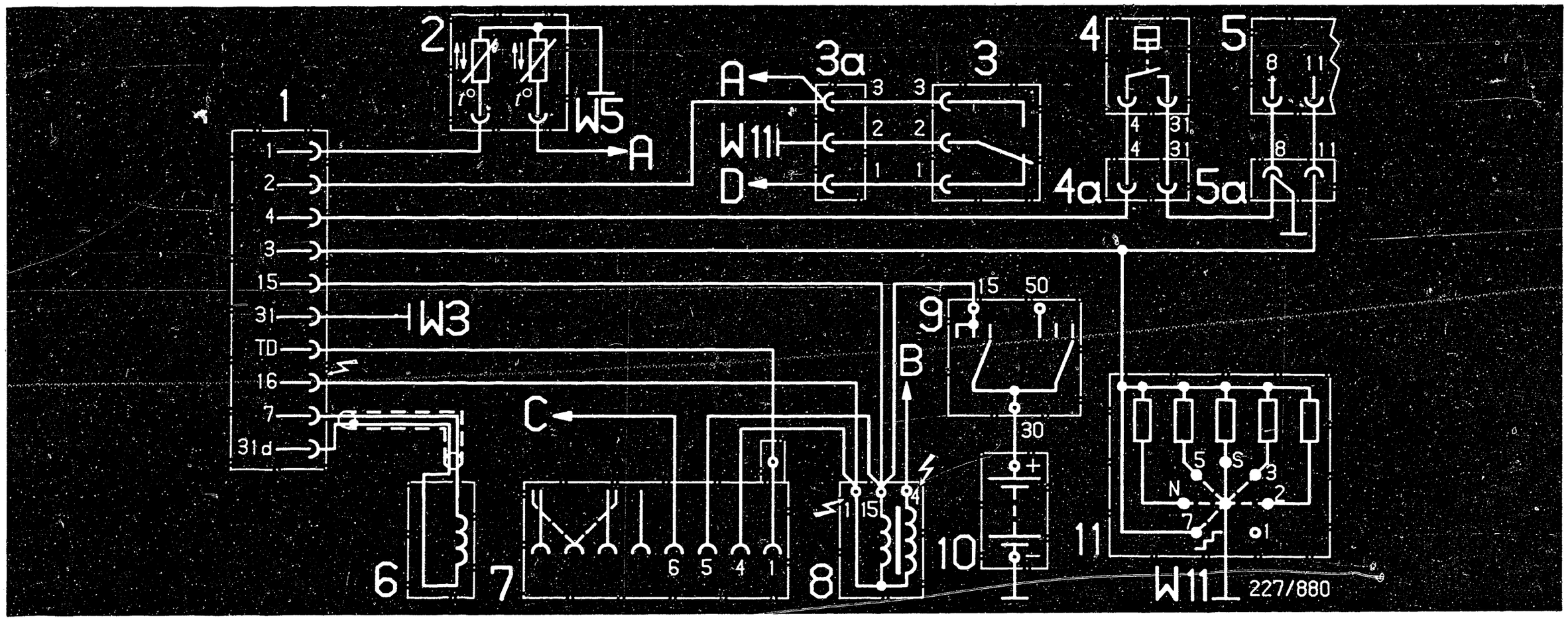
M19

Voltage, pulse generator
at cranking speed U_S > 1 V

Voltage supply, EI control unit with ignition ON	Batt. +ve
Voltage supply, primary circuit with ignition ON	Batt. +ve

M21

See Jetronic SIS microcard or Autodata test specifications for the settings for idle speed, exhaust gas etc.



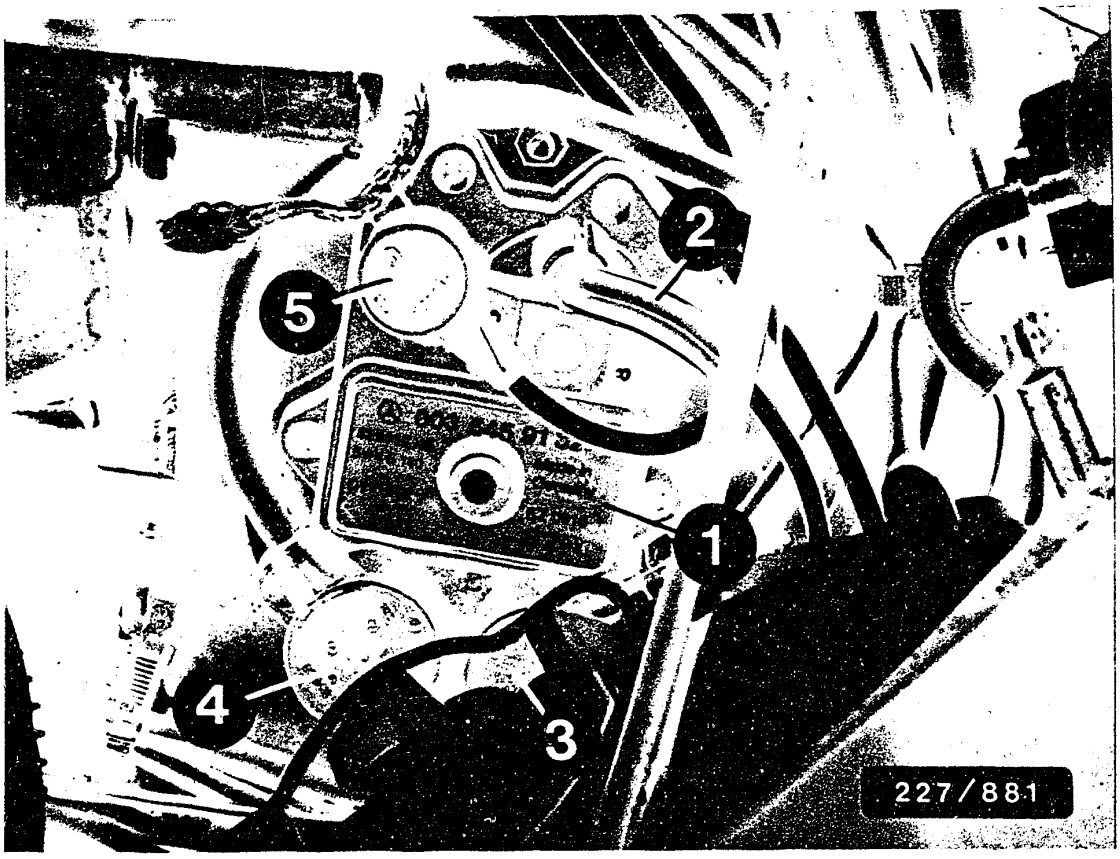
High-voltage symbols:
Danger, 400 V...25 kV

1 = EI control unit
2 = Coolant-temperature sensor (double NTC)
3 = Throttle-valve switch
3a = Plug-in connection, throttle-valve switch
4 = Transmission-overload-protection switch
4a = Plug-in connection, transmission-overload-protection switch
5 = Instrument cluster
5a = Plug-in connection, instrument cluster
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition and starting switch
10 = Battery
11 = Trimming plug, marking e.g. on EZL KAT

A = To control unit, KE-Jetronic
B = To high-voltage distributor
C = To fuse 2 (term. 30)
D = To control unit, low-idle-speed control

W3 = Ground, front left wheel house (ignition coil)
W5 = Ground, engine
W11 = Ground, engine (electr. lead connected)

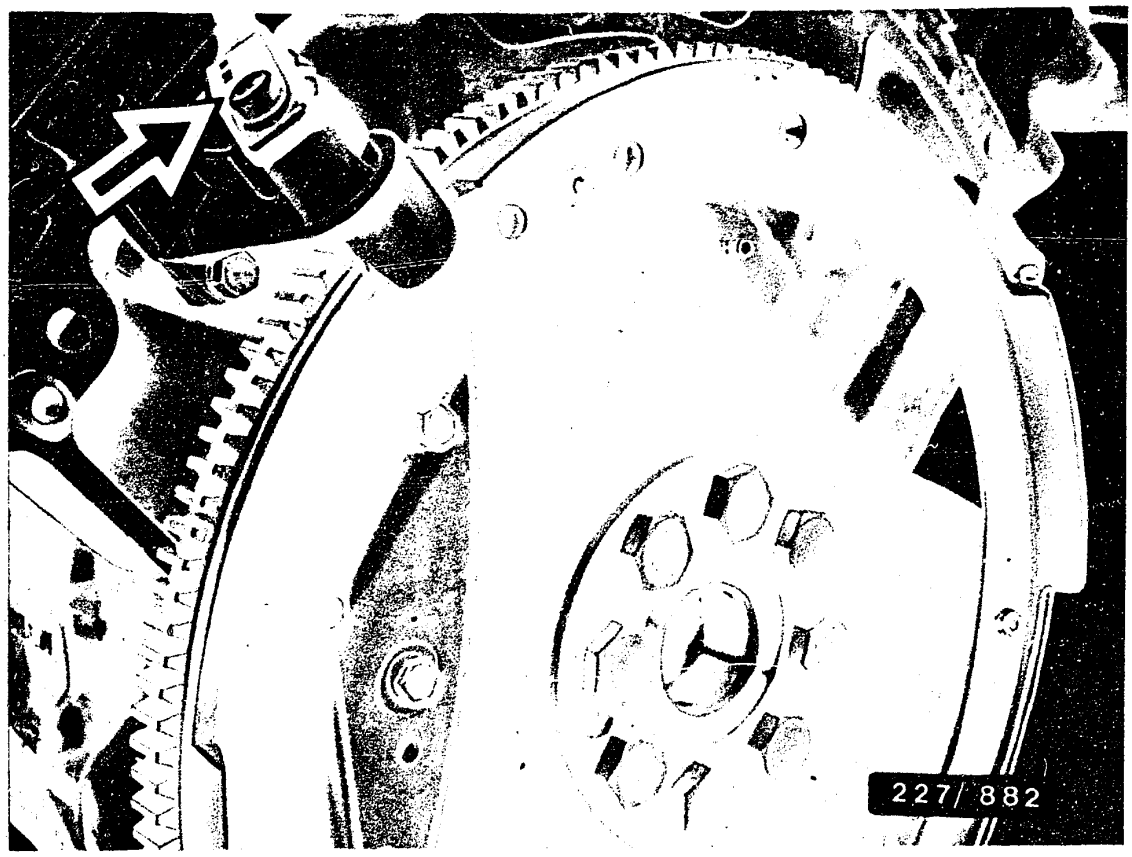
4. Electrical terminal diagram



1 = Electronic ignition control unit
2 = Vacuum hose
3 = Quadruple plug - power supply
4 = Quadruple plug - sensor
5 = Coaxial plug - pulse generator

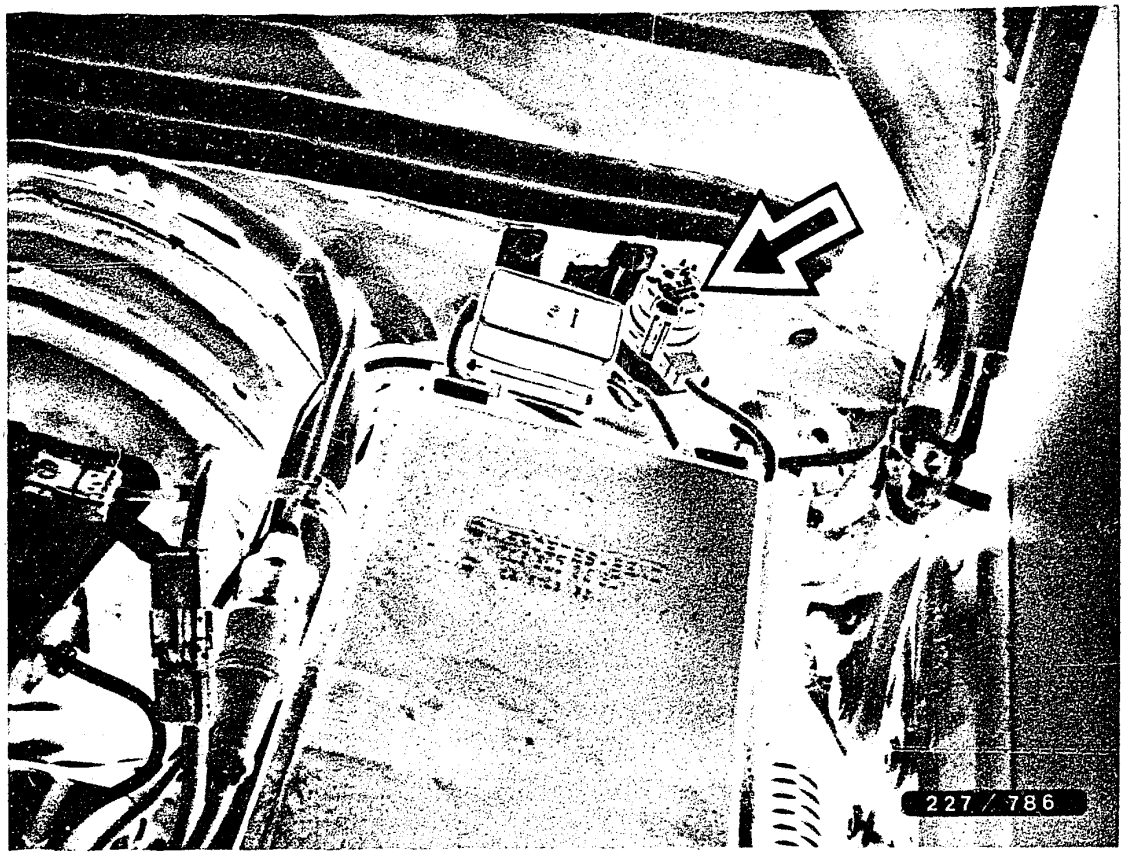
5. Installation position of components

The EI control unit is located in the front left wheel house.

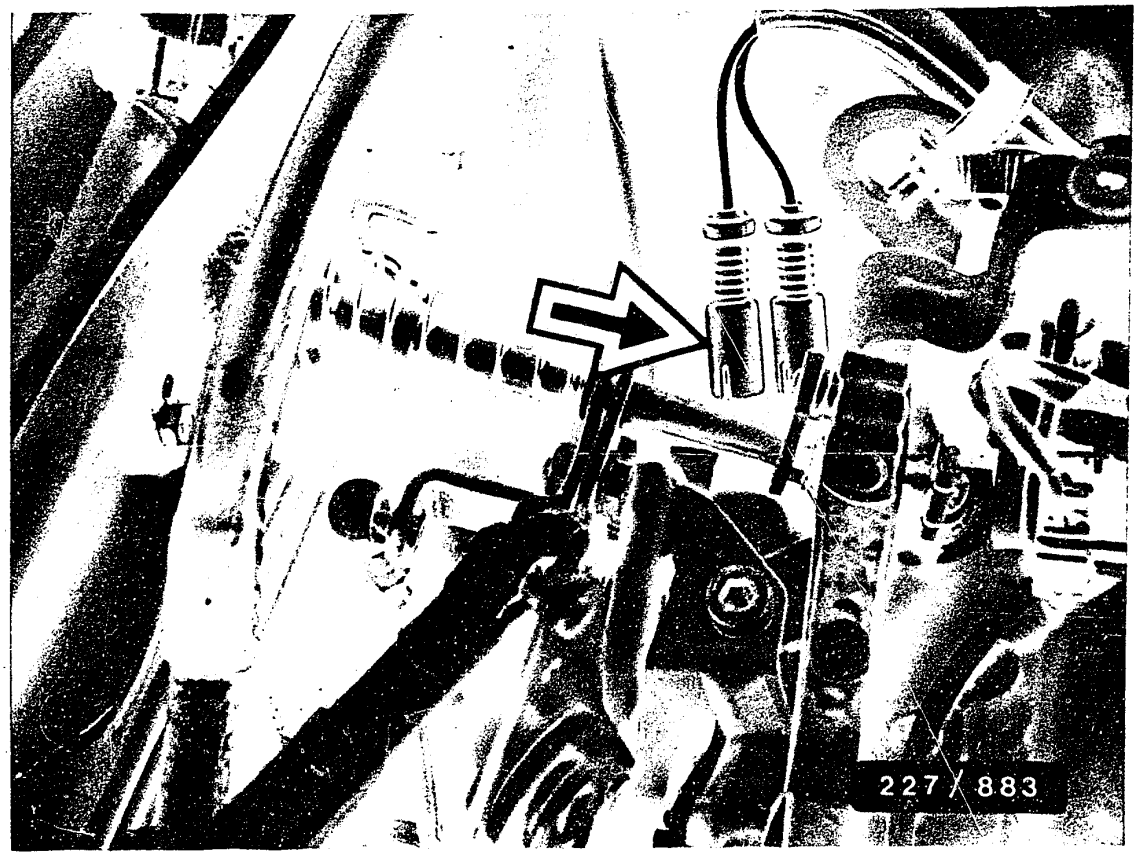


Arrow = Pulse generator

The pulse generator is located on the engine block on the left, looking in the direction of forward vehicle travel.

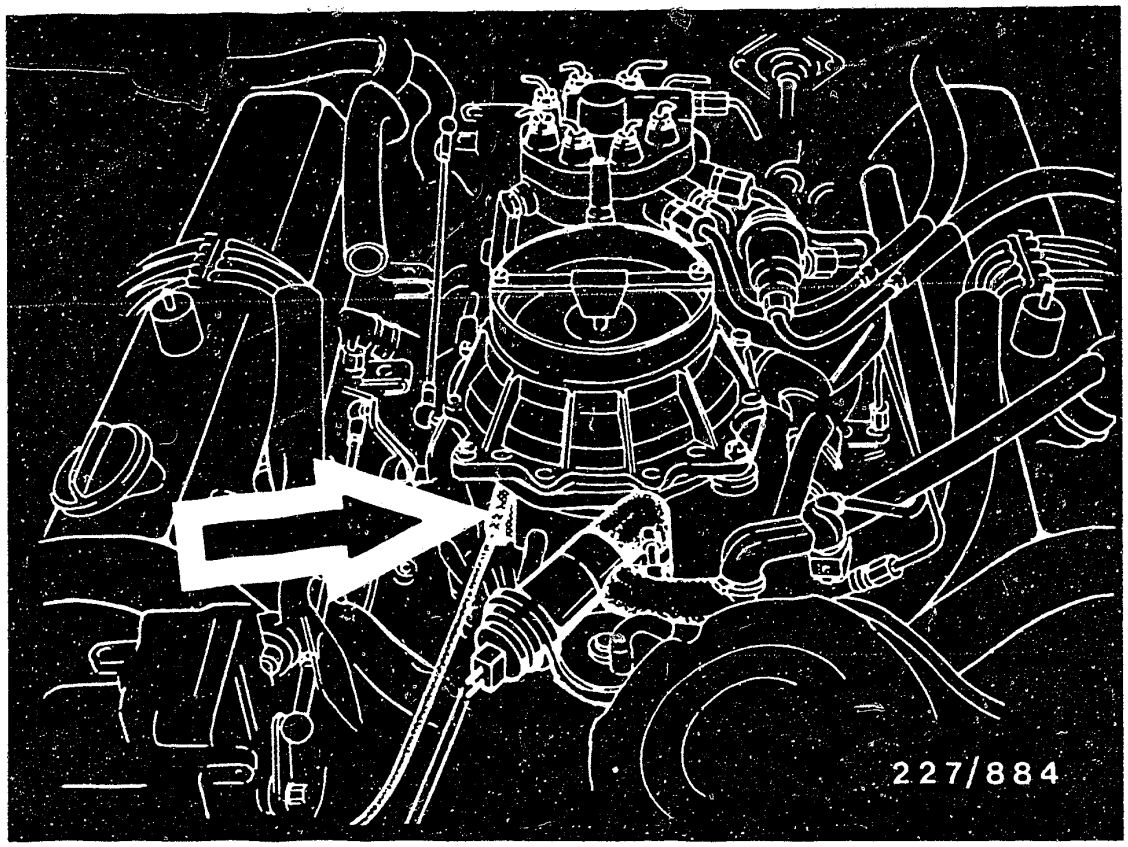


Arrow = Trimming plug, ignition



Arrow = Coolant-temperature sensor (double NTC)

The coolant-temperature sensor (green/black lead) is located on the cylinder head at the rear on the left-hand side.



Arrow = Trottle-valve switch

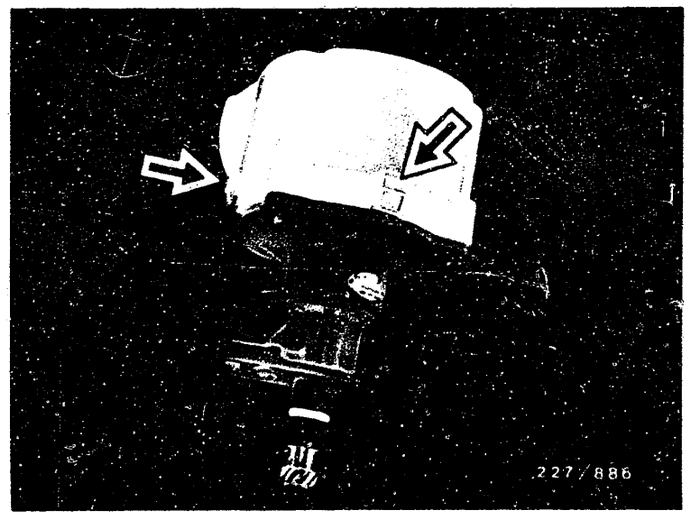
The throttle-valve switch is located on the throttle-valve assembly.

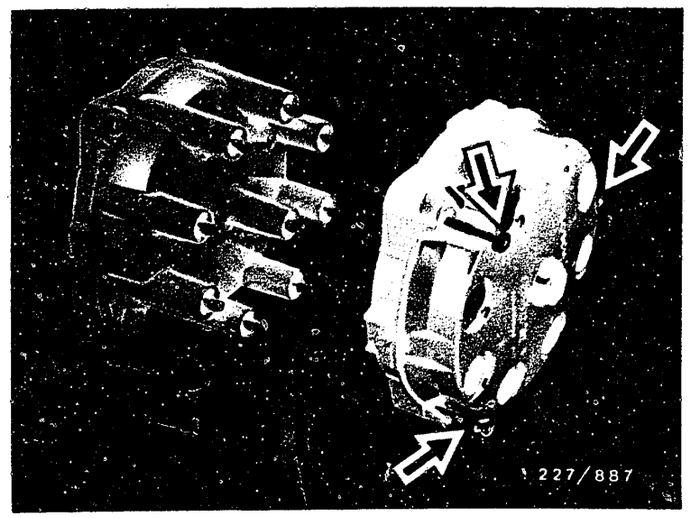
High-voltage distributor, see upper illustration.

Note on removal:

To remove the cover, unclip the three clips (arrows, center illustration) and pull the cover up.
The distributor cap is screwed on to the high-voltage distributor together with the protective cap for long-distance interference suppression with special screws (arrows, lower illustration).





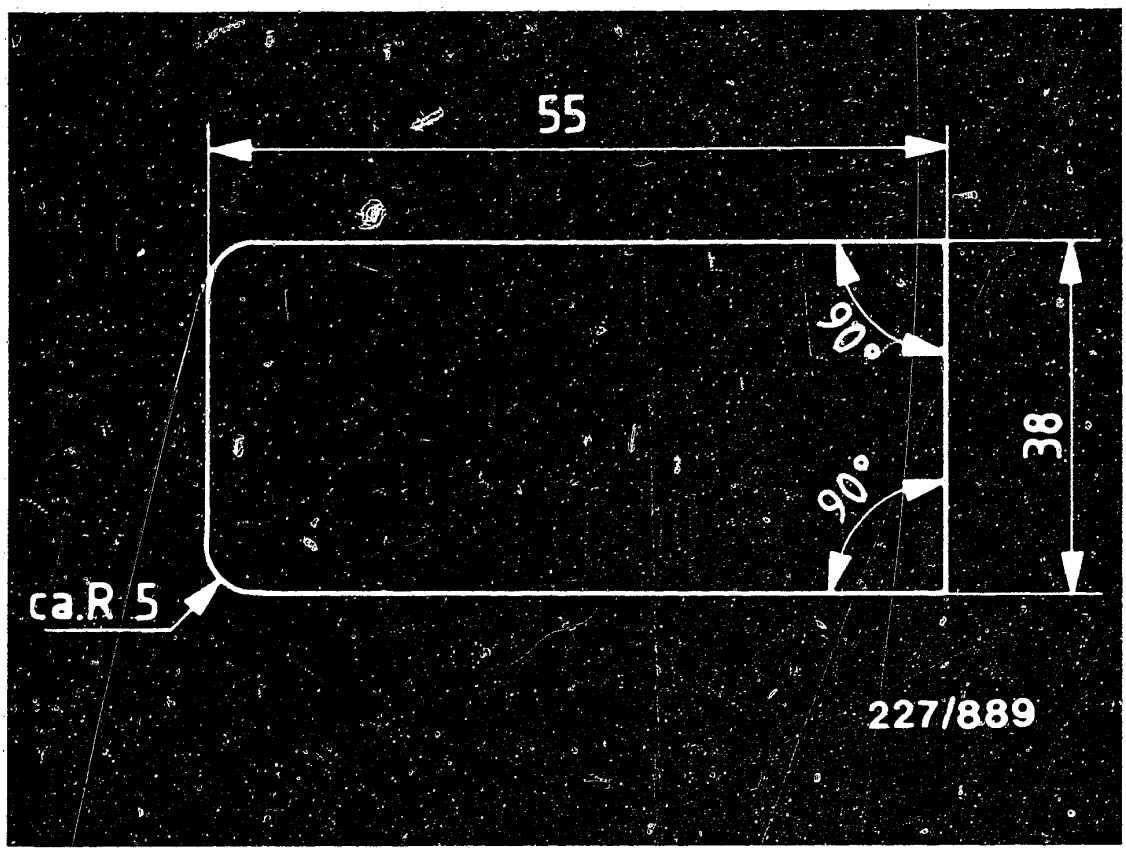




Arrow = Transmission overload-protection switch

6. Necessary test equipment and auxiliaries

Motortester e.g.	MOT 201	0 684 000 201
Pulse shaper (is required for measuring the primary voltage with MOT 201, 202, 206 and 400)		1 684 463 154
Adapter lead for diagnostic socket		1 684 463 094
Spark gap e.g. ignition-coil/ condenser tester	EFAW 106 A	0 681 100 001
or single spark gap	EF 1177/7	1 684 531 000
5 kΩ sleeve-type suppressor		0 356 500 001
Ohmmeter	ETE 014.00	0 684 101 400
or e.g.	Pontavi Wh 2	commercially available
Voltmeter e.g.	ETE 014.00	0 684 101 400
Thermal-conduction paste		5 942 860 003
Test prod, black		1 684 485 034
Test prod, red (for correct connection of test equipment at connectors)		1 684 485 035



Auxiliary tool to be fabricated by user

An auxiliary tool as shown in the sketch is required for adjusting the high-voltage distributor free from parallax.
Material: Sheet steel, approx. 1 mm thick.

7. Danger of accident on electronic ignition systems

Increased demands of modern engines on the ignition system combined with the desire for freedom of maintenance have recently led to electronic ignition systems being fitted as standard. Usually the ignition power of electronic systems (of almost all manufacturers) is higher than that of conventional systems, and there are signs of further increases in power. Electronic ignition systems thus reach a power range which can be highly dangerous if live parts of terminals are touched (both on the primary as well as the secondary sides).

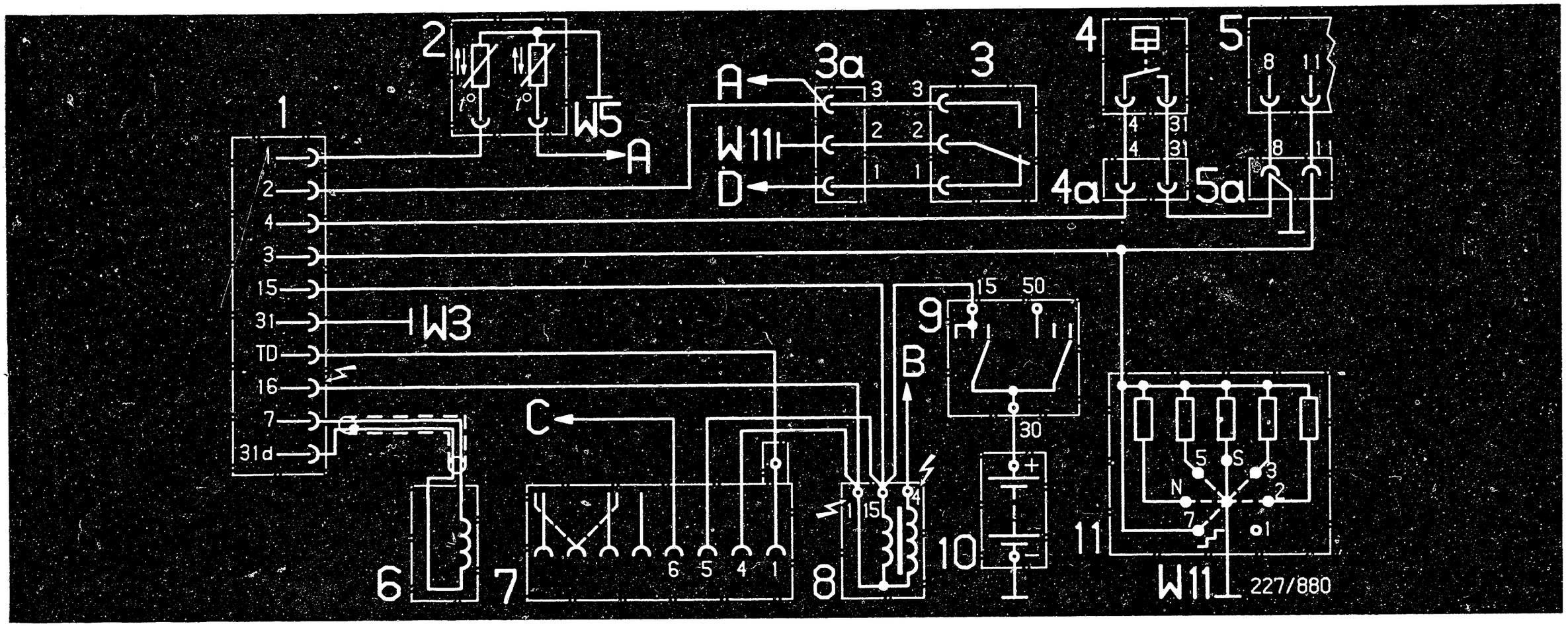
In this connection we should like to point out that the VDE regulations, in particular VDE 0104/7.67 and/or the respective national regulations must be followed when testing or working on the ignition system.

The ignition should always be switched off when working on the ignition system (switch off ignition or voltage source). Such work includes:

- Connecting of engine test equipment (timing light, dwell-tach tester, ignition oscilloscope etc.).
- Replacing parts of the ignition system (spark plug, ignition coil, ignition distributor, ignition cable etc.).

If, while testing the ignition system or during adjustment work on the engine (e.g. KE-Jetronic), it becomes necessary to switch on the ignition (switch on ignition or voltage source), the above-mentioned dangerous voltages occur over the entire system.

The danger of accident exists, therefore, not only on the individual assemblies of the ignition system (e. g. ignition distributor, ignition coil, trigger box, ignition harness), but also on the wiring harness (e. g. tachometer connection, diagnostic plug), at plug-in connections and test equipment.



High-voltage symbols:
Danger, 400 V...25 kV

1 = EI control unit
2 = Coolant-temperature sensor (double NTC)
3 = Throttle-valve switch
3a = Plug-in connection, throttle-valve switch
4 = Transmission-overload-protection switch
4a = Plug-in connection, transmission-overload-protection switch
5 = Instrument cluster
5a = Plug-in connection, instrument cluster
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition and starting switch
10 = Battery
11 = Trimming plug, marking e.g. on EZL KAT

A = To control unit, KE-Jetronic
B = To high-voltage distributor
C = To fuse 2 (term. 30)
D = To control unit, low-idle-speed control

W3 = Ground, front left wheel house (ignition coil)
W5 = Ground, engine
W11 = Ground, engine (electr. lead connected)

Electrical terminal diagram

The hazard locations are identified with high voltage arrows using, as an example, the terminal diagram for an electronic ignition system.

8. Incorrect indication of engine speed, dwell angle and ignition point

In the case of ignition systems with control unit 0 227 400 6.. or control units from Siemens (electronic ignition) with current limitation, there can be an incorrect reading for engine speed, dwell angle, and ignition timing on the test instruments.

For further details see coordinates N 7 - N 11.

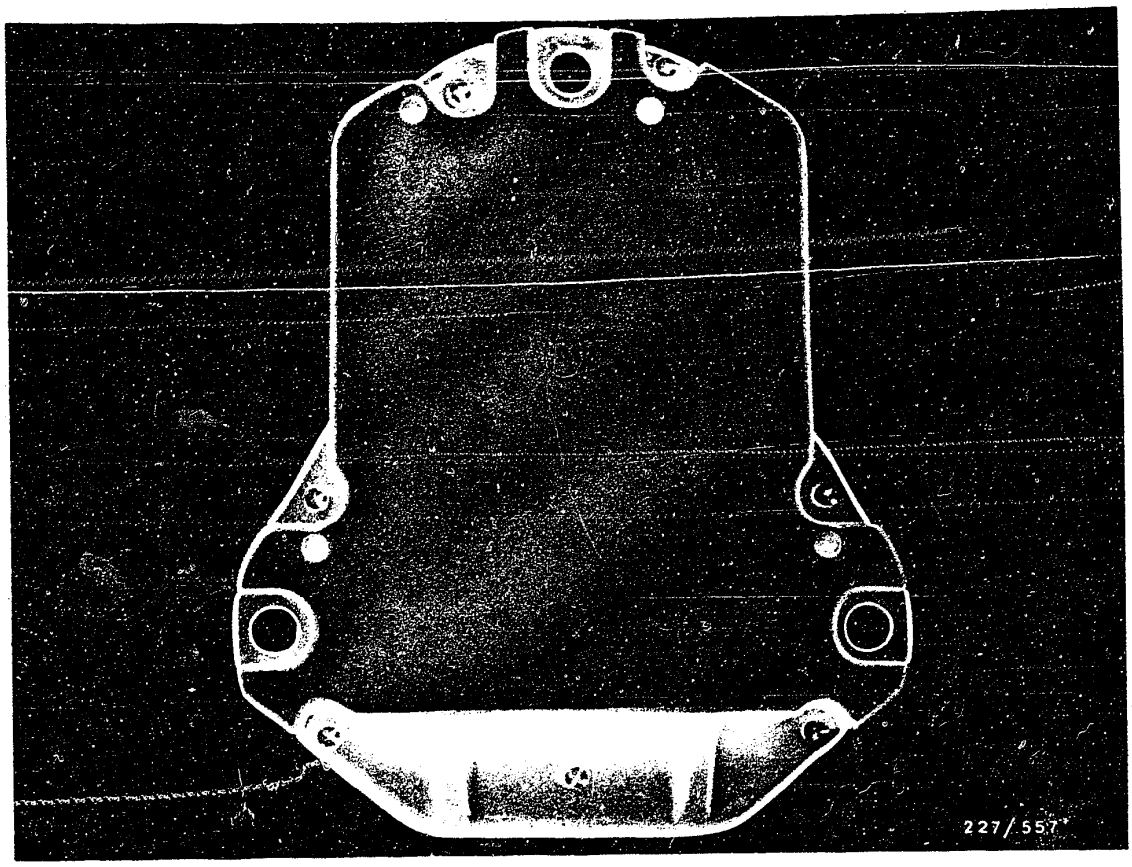
9. Important vehicle information

- Resistance measurements must only be performed with the ignition switched off or with the battery disconnected (measuring instrument defective).
- For a compression test, disconnect the coaxial plug (pulse generator) from the electronic ignition control unit.
- Never disconnect the battery while the engine is running.
- A starting assist with more 16 Volts or with a quick-charger is not permitted.
- The specified ignition coil (see Part.No.) must not be replaced with a different ignition coil.
- No suppression capacitor must be connected to ignition coil terminal 1.
- Ignition coil terminal 1 must not be brought into contact with ground as a theft-proofing measure (ignition coil will be destroyed when ignition is switched on).
- No battery + or test lamp must be connected to ignition coil terminal 1 (the electronic ignition control unit is destroyed).
- The ignition lead from the ignition coil Term. 4 to the high voltage distributor Term. 4 must not be disconnected during operation.
- There must be no arcing from ignition coil terminal 4 to ignition coil terminal 1 and 15.
 The electronic ignition control unit can be destroyed.

- If the poles are reversed on the ignition coil (Term. 1 and Term. 15) there are severe losses of ignition energy, causing missing. In addition, the electronic ignition control unit is overloaded. In order to preclude reversal of poles, the terminal studs have different diameters. (M5 and M6)

- In order to avoid destruction of the electronic ignition control unit, the secondary end of the ignition system must have interference suppression of min. 2 kΩ. The original distributor rotor must be installed with an interference suppression resistor of 1 kΩ.

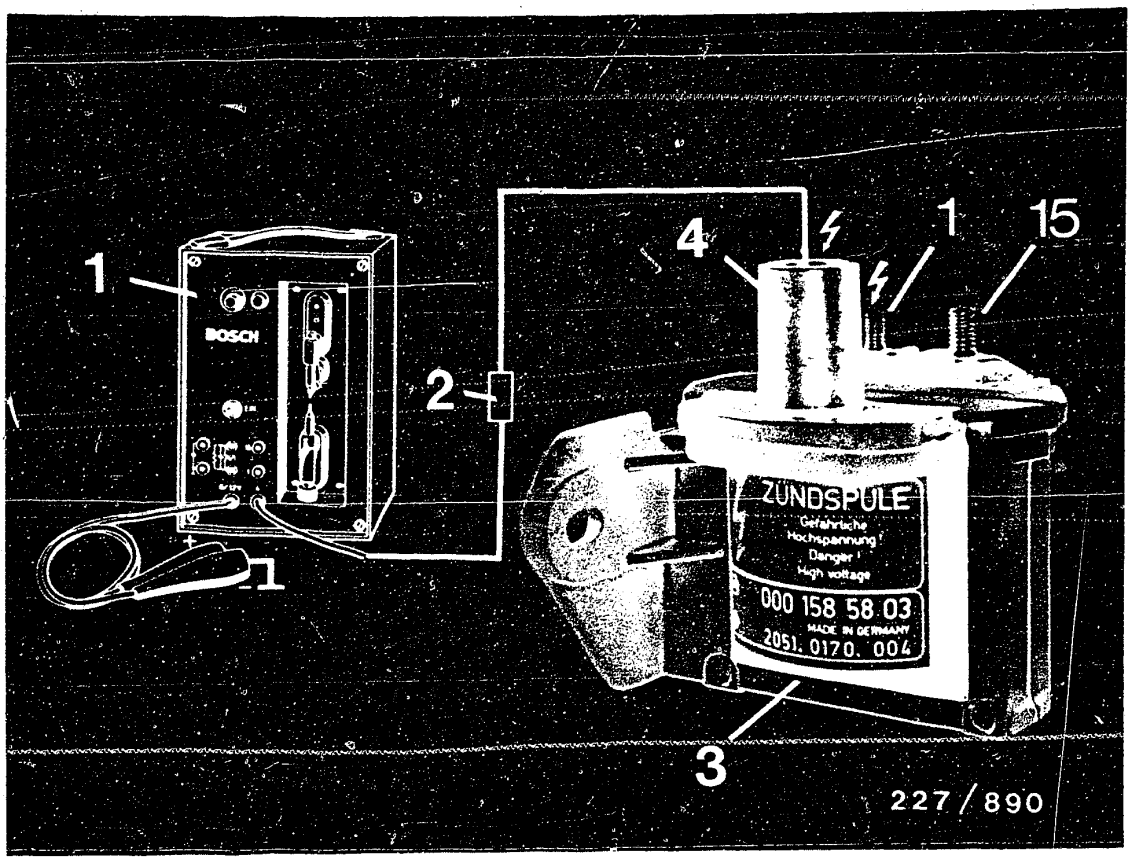
- If the poles on the battery are incorrectly connected, the electronic ignition control unit and the ignition coil are destroyed.



- Before putting on the electronic ignition control unit, the base plate (see the Figure, bright surface) must be coated with a heat conduction paste.

 Before mounting the trigger box, the base plate must be coated with thermal conduction paste. Apply thermal conduction paste only with a suitable object (screwdriver, etc.).

 Do not apply thermal conduction paste to painted parts.



High voltage arrows:
Warning, 400 V ... 25 kV

1 = Spark gap
2 = 5 kΩ sleeve-type suppressor
3 = Ignition coil

- In order to prevent the trigger box from being irreparably damaged, when using a spark gap, an interference-suppression resistor of at least 2 kΩ must be connected between the spark gap and ignition coil terminal 4, e. g. sleeve-type suppressor (5 kΩ) 0 356 500 001.

Adjust ignition point to the available fuel

1. General

These vehicles can be operated with PREMIUM and REGULAR fuel, leaded or lead-free. This requires the ignition point to be adjusted appropriately.
To adjust, pull adjustment plug out until the stop is reached, turn to the correct position, and press back in. See illustrations.
Code letter S on adjustment plug = lead-free or leaded premium fuel
N on adjustment plug = lead-free or leaded regular fuel.
ECE on adjustment plug = non-lambda operation
KAT on adjustment plug = lambda operation

This adjustment for PREMIUM or REGULAR FUEL can also be undertaken by the customer.

Note:
The best performance and fuel consumption is obtained with PREMIUM FUEL. If a change is made from PREMIUM to REGULAR fuel, the ignition-timing adjustment must be altered (danger of damage to engine). The ignition-timing adjustment must also be changed when switching from REGULAR to PREMIUM fuel.

2. INITIAL IGNITION-TIMING ADJUSTMENT on vehicles WITHOUT CATALYTIC CONVERTER

2.1 Ignition point for leaded and lead-free PREMIUM FUEL

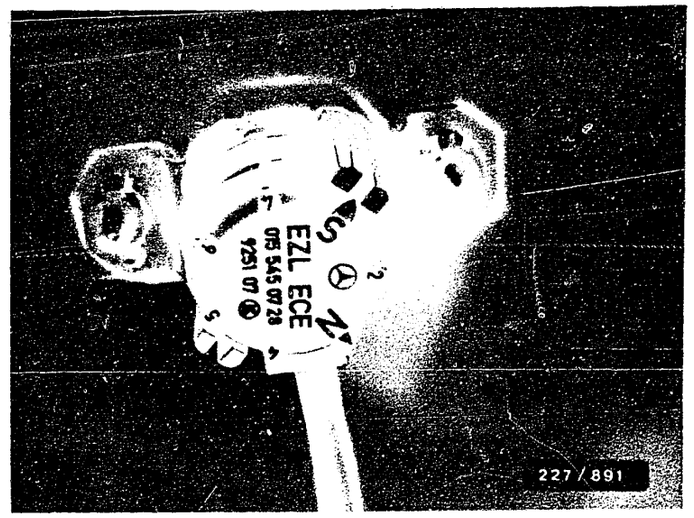
ADJUSTMENT PLUG with legend EZL ECE (code color white) in POSITION "S".
See upper illustration.

Correction adjustment for the workshop

For poor-quality premium fuel, set the adjustment plug in position "2".
See illustration.
The ignition point is RETARDED by 3°.

2.2 Ignition point for leaded and lead-free REGULAR FUEL

ADJUSTMENT PLUG with EZL ECE legend (code color white) in position "N".
See lower illustration.



Adjustment plug position "S"

Adjustment plug position "N"



3. INITIAL IGNITION-TIMING ADJUSTMENT with vehicles WITH CATALYTIC CONVERTER

3.1 Ignition point for lead-free PREMIUM FUEL

ADJUSTMENT PLUG with legend EZL KAT (code color green) in position "S". See upper illustration.

Correction adjustment for the workshop

For poor-quality premium fuel, set adjustment plug to position "5". See upper illustration.

Ignition point is RETARDED by 3°.

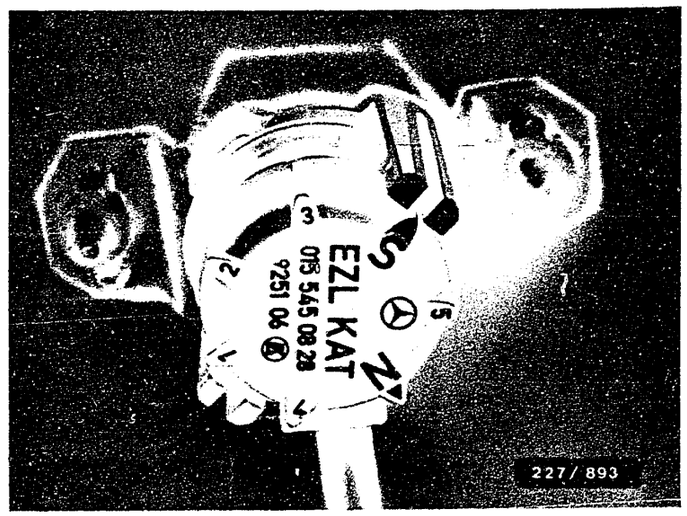
3.2 Ignition point for lead-free REGULAR FUEL

ADJUSTMENT PLUG with legend EZL KAT (code color green) in POSITION "N". See lower illustration.

Correction adjustment for the workshop

For poor-quality regular fuel, set adjustment plug to position "7". See lower illustration.

Note: Trimming-plug position "7" must not be used, since this signal is used for the transmission-overload proctection function.



Adjustment plug position "S"

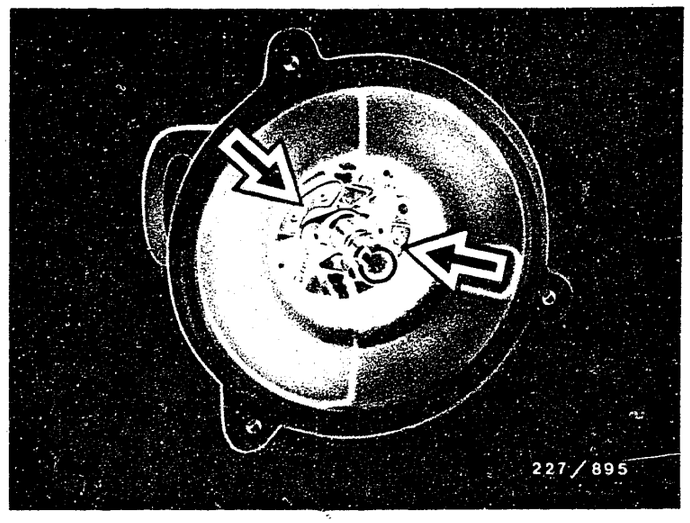
Adjustment plug position "N"



Distributor-rotor correction

The high-voltage distributor has a centrifugal-advance correction feature of the distributor rotor. See illustration, arrow.

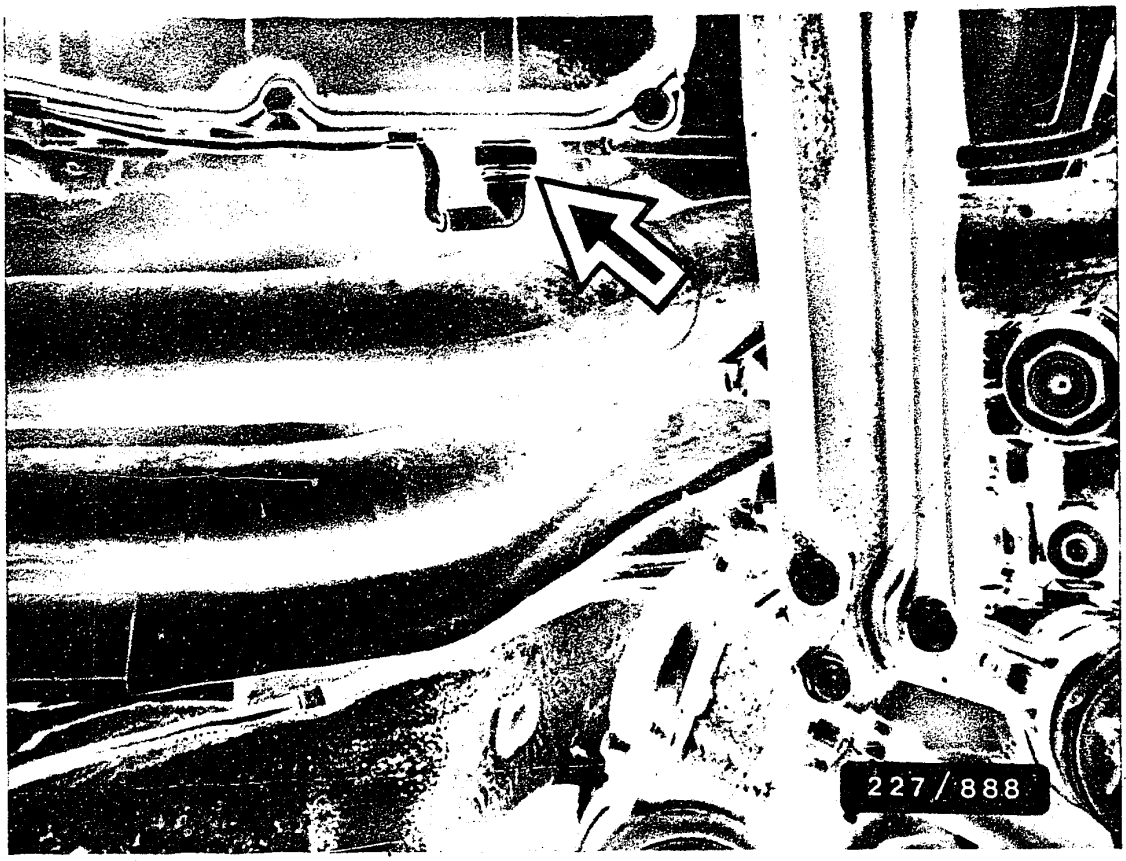
This feature ensures that even under extreme spark-advance angles, there is always sufficient insulation clearance between the distributor rotor and the neighboring distributor-cap electrodes.
Prerequisite for this is, however, very precise coordination (setting) of the distributor rotor and distributor housing.
The rotor and housing must be set using a user-fabricated auxiliary tool.



Note: The ignition point cannot be set by turning the high-voltage distributor, because the ignition point is set by the EI control unit.

Throttle-valve-switch full-load contact

As the full-load contact closes, a fixed characteristic curve is output by the EI control unit.



Arrow = Transmission-overload-protection switch

Transmission-overload protection

In order to prevent the transmission brake bands from being overloaded when shifting up gear, the ignition point is retarded to 10° crankshaft before TDC by the EI control unit for a brief moment (0.4 s). Control/ triggering is by means of the transmission-overload-protection switch. See illustration, arrow.

Note: If the transmission overload-protection feature is defective, the EZ control unit operates in limp-home mode.

Top-speed limitation (on 220 kW engine only)

When a top speed of approx. 250 km/h is reached, a ground signal is sent from the electronic speedometer to term. 3 of the EI control unit. This leads to RETARDATION of the ignition point and thus reduces the power output of the engine.
The ignition point is retarded to 10° crankshaft before TDC.
When the speed drops below approx. 245 km/h, the top-speed-limitation feature is cancelled.

10. Trouble-shooting

10.1 How to use the trouble-shooting chart

The trouble-shooting chart starting on Coordinate L 3 contains customer complaint (fault symptom), cause of trouble, test instructions and coordinate references.

The possible cause of the fault should be selected from the trouble-shooting chart in accordance with the customer complaint (fault symptom).

If the cause of the fault is not clear, start testing with the detailed, self-contained trouble-shooting program beginning on Coordinate L 9.

If the cause of the fault is clear from the trouble-shooting chart, direct trouble-shooting is possible by going to the stated coordinate without having to perform the entire trouble-shooting program for each fault.
If there is no coordinate reference, trouble-shooting must be performed in accordance with the "Test instructions" column.

10.2 Procedure - trouble-shooting program

The trouble-shooting program starting on Coordinate L 9 is divided into 3 rows of boxes.

The left-hand row contains test instructions and test specifications.

The center row contains repair instructions.

The right-hand row contains the illustrations/terminal diagrams belonging to the text and the explanations of the items in the picture.

If the questions asked in the left-hand row can be answered conclusively with "yes", then proceed to the next test down.

If the answer to the question is "no", branch to the center row and carry out the tests given there.

10.3 Before testing, make sure of the following:

Battery fully charged, fuel system O.K., engine mechanically O.K. (e. g. compression, valve clearance etc.). Ambient temperature/ignition system temperature 0^{o} to 100^{o} C (temperature has a considerable effect on measured values).

10.4 Trouble-shooting chart

Customer complaint (fault symptom)

1. Starting motor operates, but engine fails to start
2. Rough idling
3. Poor throttle response
4. Engine lacks power
5. Misfiring
6. Fuel consumption too high
7. Engine pings when accelerating
8. Backfiring
9. Engine becomes too hot

1	2	3	4	5	6	7	8	9	Cause of fault	Test instructions	Coordinates
●	●	●	●	●	●	●	●	●	Unclear	Perform detailed trouble-shooting	L 9
●	●	●	●	●	●	●	●		Spark plugs defective	Assessment by means of ignition oscilloscope or visual examination of spark plug when removed	----
●	●	●	●	●					Shunt on secondary side	Evaluation of the ignition coil, high voltage distributor, ignition harness, and spark plug by means of the ignition oscillogram or a visual inspection	----
●	●	●	●	●					Open circuit on secondary side	Assessment of ignition coil, ignition distributor, ignition harness and spark plug by means of ignition oscilloscope, or continuity test with ohmmeter	----
		●	●	●	●				Interference-suppression resistors defective	Assessment by means of ignition oscilloscope or resistance measurement	----
●							●		Firing order not O.K.	Firing order 1 - 5 - 4 - 8 - 6 - 3 - 7 - 2	----
●	●	●	●	●					Ignition coil defective	---	L 11

Trouble-shooting chart (Continued)
Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start	2. Rough idling	3. Poor throttle response, flat spot during acceleration	4. Engine lacks power	5. Engine misfiring	6. Fuel consumption too high	7. Engine pings when accelerating	8. Backfiring	9. Engine overheats	Cause of trouble	Test instructions	Coordinates
●	●		●			●			High-voltage-distributor setting not O.K.	-----	L 13
●									Contact resistance, ignition coil and/or EI control unit not O.K.	---	L 17
			●						Transmission-overload protection not O.K. Note: Defective transmission-overload protection may become noticeable through misfiring.	---	L 19
		●		●	●		●		Pressure sensor not O.K.	----	L 23
		●		●					Coolant-temperature sensor not O.K.	---	M 1
		●		●	●				Spark-advance angle not O.K.	In order to avoid incorrect measurement, always test in accordance with coordinate details.	L 19 - M 3
	●			●	●				Throttle-valve switch (full-load contact) not O.K.	---	M 9

Trouble-shooting chart (continued)

Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start	2. Rough idle	3. Poor throttle take-up (flat spot on acceleration)	4. Insufficient engine power	5. Misfiring	6. Fuel consumption too high	7. Engine pinging when accelerating	8. Backfiring	9. Engine overheating	Cause of trouble	Test instructions	Coordinates
				●					EZ control unit/ignition coil power supply defective (engine idling)	---	M 11
●									Peak-coil-current cutoff (EZ control unit) defective	---	M 13
				●					Primary voltage (EZ control unit) incorrect	---	M 15
●									Pulse-generator insulation, internal resistance, voltage incorrect	---	M 17 - M 19
●									EZ control unit power supply incorrect (ignition ON)	---	M 21
●									Primary-circuit power supply incorrect (ignition ON)	---	M 21

10.5 Detailed trouble-shooting program

Test primary signal. If no oscilloscope or tachometer available, check whether ignition spark across spark gab.
Remove the protective cap from the ignition coil.

Primary signal testing with oscilloscope
Connect oscilloscope to ignition coil as per operating instructions.
Start engine.
Oscilloscope must indicate a primary voltage (of any value).

Primary signal testing with tachometer
Connect tachometer to ignition coil as per operating instructions.
Start engine.
Tachometer must indicate a reading (of any value)

Primary signal testing with tachometer
Connect tachometer to ignition coil as per operating instructions.
Start engine.
Tachometer must indicate a reading (of any value).

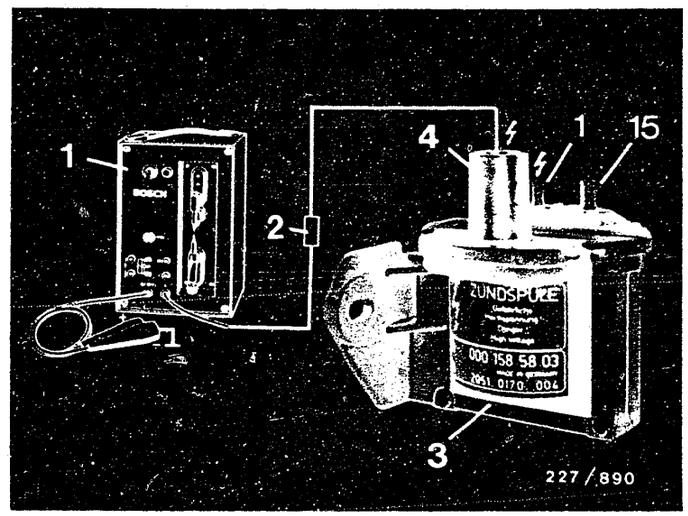
Ignition spark testing with spark gap
Remove H.T. ignition cable terminal 4 from ignition coil. Connect spark gap including sleeve-type suppressor (5 kΩ) to ignition coil. Adjust spark gap to 5 mm.
Start engine.
There must be sparks across the spark gap.
Primary signal present or ignition sparks across spark gap?

no → If no primary signal or no ignition spark, continue testing at M17.

Tests from L 11 onwards not necessery.

yes ↓

Continued on L11/L12



High voltage arrows:
Warning, 400 V ... 25 kV!

1 = Spark gap
2 = 5 kΩ sleeve-type suppressor
3 = ignition coil

yes

Check distributor cap, distributor rotor, H.T. ignition cables and spark plugs.

High-tension side O.K.?

no → Repair high-tension side.

yes

Check the ignition coil.

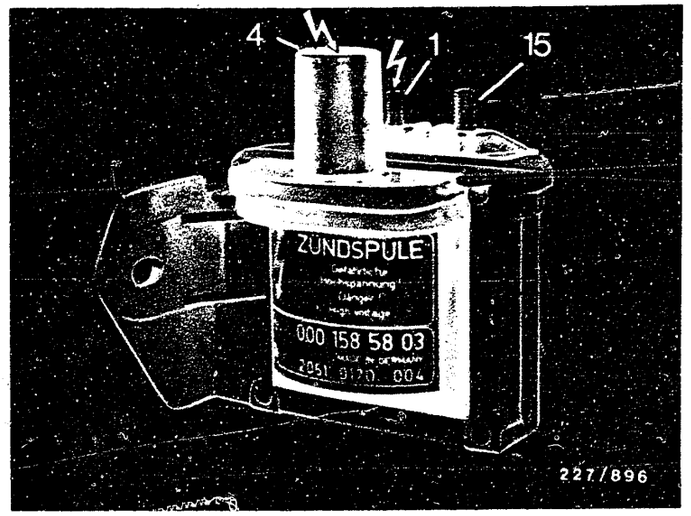
Remove the protective cap from the ignition coil.
Primary ignition coil (Term. 15 and 1)
0,20...0,40Ω (Take resistance of measuring lead and test prods into consideration.)
Secondary ignition coil (Term. 1 and 4)
7.3...13.2 kΩ.

Are values for resistance O.K.?

no → Replace ignition coil.

yes

Continued on L13/L14



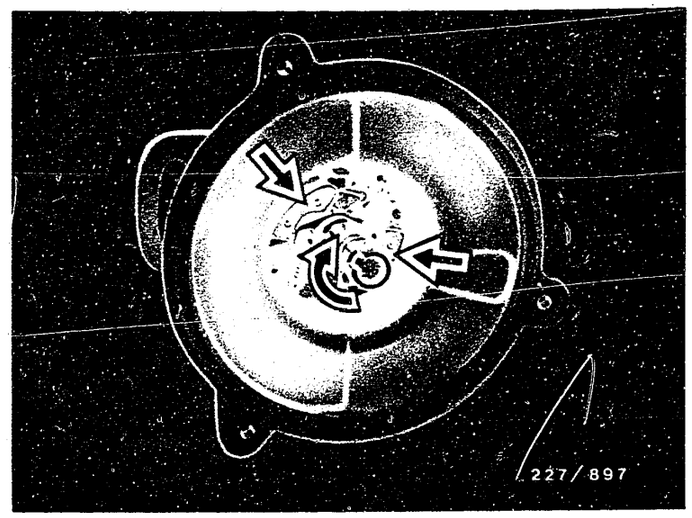
High voltage arrows:
Warning, 400 V ... 25 kV

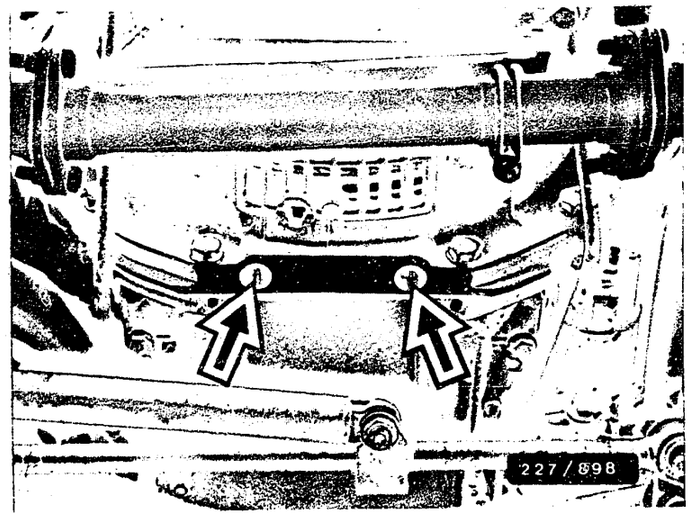
yes

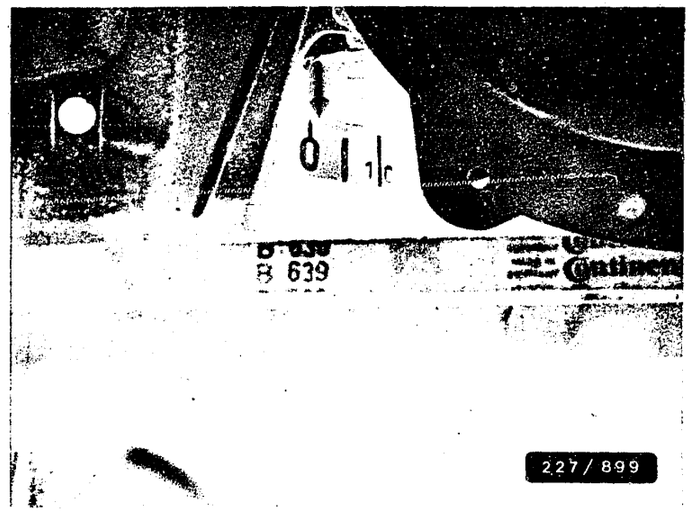
Test <u>high-voltage-distributor setting</u>.
Remove high-voltage-distributor cover, protective cap, distributor cap, and dust-protection cover.
Visual examination: check driver of distributor rotor and flyweights for freedom of movement and mechanical damage. See arrows, upper illustration.
Using a screwdriver, set cyl. 1 of the engine to TDC via starting-motor ring gear (opening, transmission bell housing - center illustration). .
See lower illustration.
TDC adjustment must be free from backlash and carried out very precisely. TDC adjustment (crankshaft, timing chain etc.) is guaranteed to be free of backlash if the engine is turned in the DIRECTION OF ROTATION (to the left as seen in the forward direction of travel).

yes

Continued on L15/L16





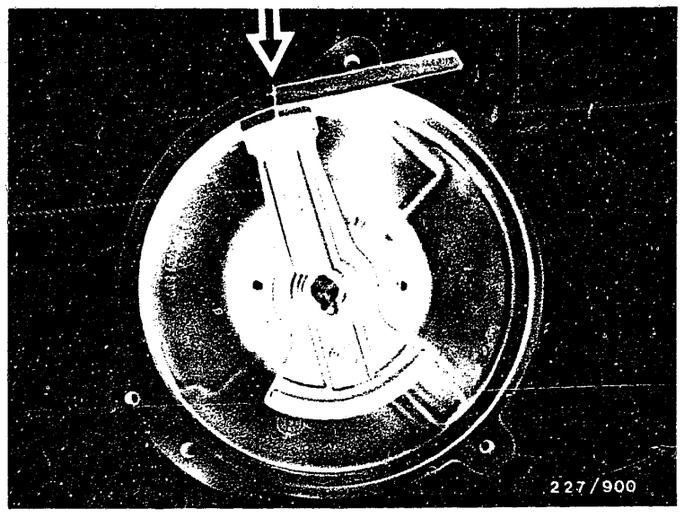


yes

Position user-fabricated auxiliary tool on to the high-voltage-distributor housing in such a way that its front edge aligns with the groove of the distributor housing.
See upper illustration, arrow.
Tilt auxiliary tool towards the center of the distributor.
Push the distributor rotor by hand opposed to the direction of rotation.
See lower illustration, arrow.
Notch of the distributor rotor must align with the front edge of the auxiliary tool.

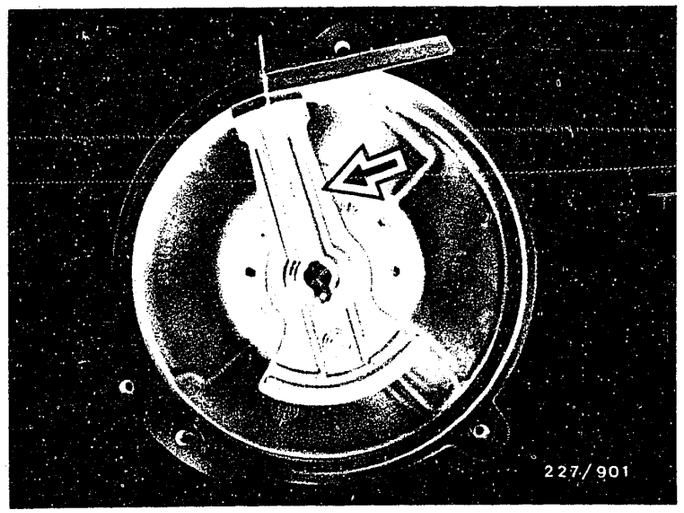
High-voltage-distributor setting O.K.?

no → Adjust high-voltage distributor.



yes

Continued on L17/L18



Engine running? — no →

1. Disconnect the negative and positive leads from the battery.

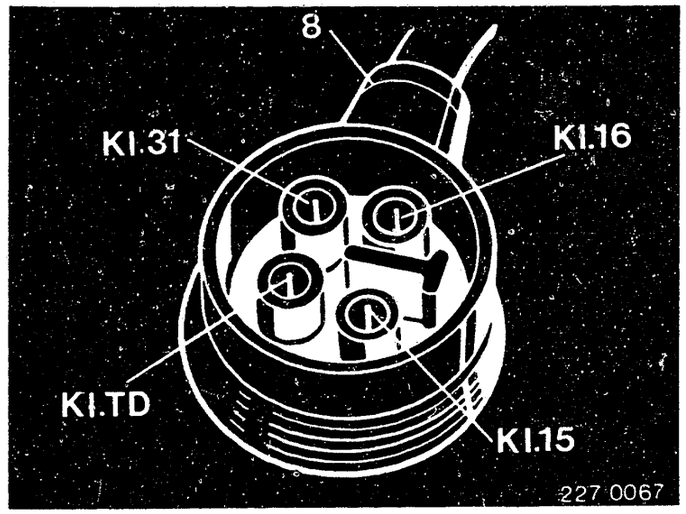
Disconnect the electronic ignition control unit plug. Switch the ignition on.

Check the leads from the positive battery **terminal to the electronic ignition control unit plug Term. 15 and the leads from the negative battery terminal to the electronic ignition control unit plug Term. 31 for contact resistances. Max. total contact resistance 0.3Ω. (Take resistance of test lead into consideration). Eliminate contact resistances.**

2. Check the leads from the positive battery terminal to the ignition coil Term. 15 and the lead from the ignition coil Term. 1 to the electronic ignition control unit plug Term. 16 for contact resistance. Max. total contact resistance 0.3 Ω. (Take the resistance of the test lead into consideration). Eliminate any contact resistance.

3. If points 1 and 2 are OK, try installing the prescribed new ignition coil. If engine still does not run, re-install "old" ignition coil and replace the EI control unit.

yes



8 = EI control unit plug

Continued on L19/L20

yes

Check transmission overload protection.

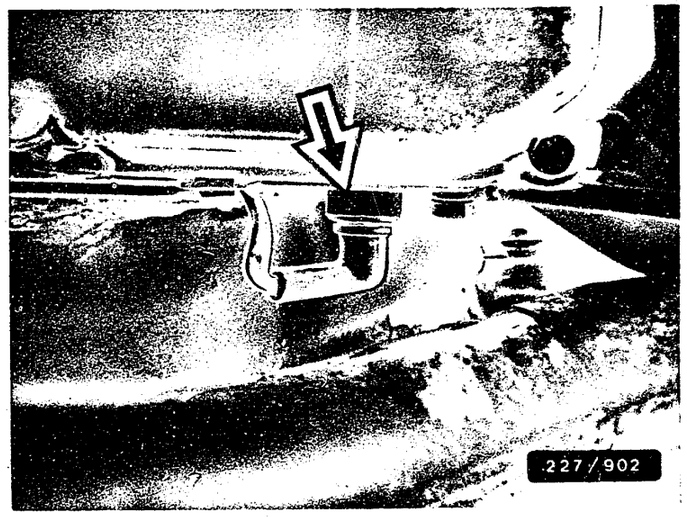
Loosen union nut on transmission overload-protection switch and disconnect connector. See arrow in top picture.
Connect ohmmeter to transmission overload-protection switch. See bottom picture.
Operate engine at idle.
Depress foot-operated parking brake.
Attention: Observe the safety regulations for the following test (e.g. chocks at the rear wheels).

See table for resistance values for respective selector-lever position:

Driving position	Resistance
"N" or "P"	= > 20 kΩ
"D"	= < 1 Ω

Resistance values O.K.?

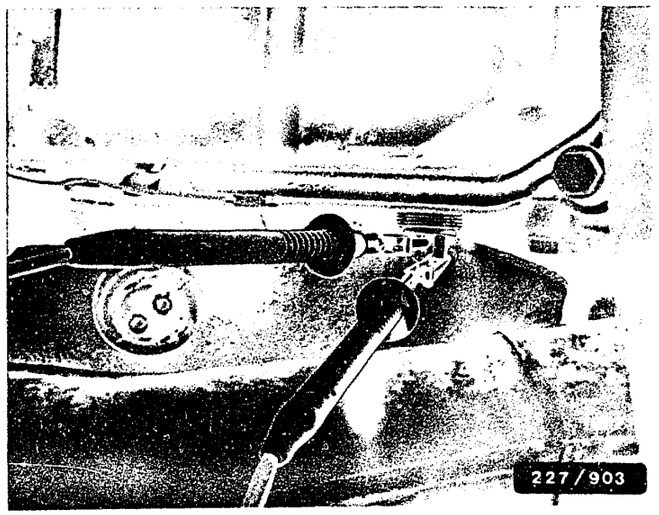
no → Replace transmission overload-protection switch. Repeat test. If resistance values still not obtained, repair transmission (DB dealer).



Arrow = Transmission-overload-protection switch

yes

Continued on L21/L22

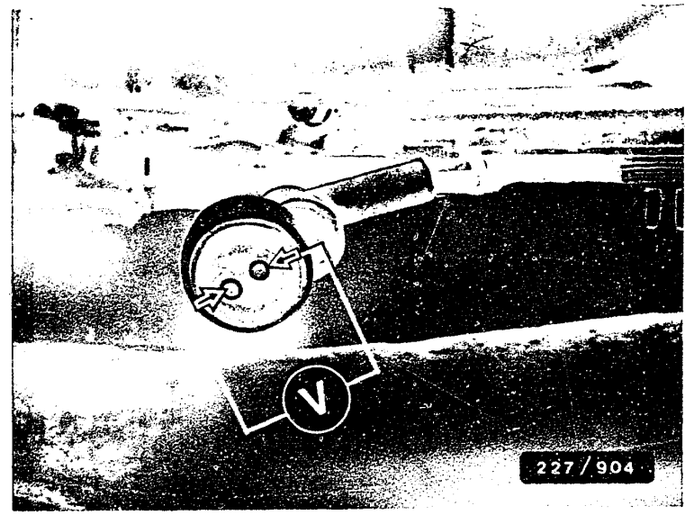


yes

Switch off ignition.
EI control-unit plugs are connected.
Connect voltmeter to disconnected coupling of the transmission-overload-protection plug.
See illustration.
Switch on ignition.
Voltmeter must indicate approx. battery voltage.
Voltage value O.K.?

no

Test connection on both positive and negative sides for open circuit.
If no open circuit was present, replace EI control unit.



yes

Continued on L23/L24

yes

Test pressure sensor.
Connect motortester to diagnostic socket using adapter cable. Disconnect vacuum hose from EI control unit. See upper illustration, arrow.
Run engine at 2000 min^{-1}.
Read off spark-advance angle.

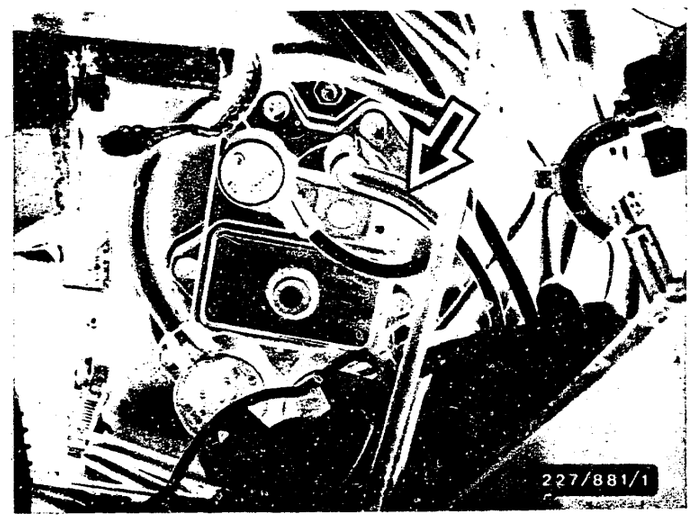
Connect vacuum hose to EI control unit.
Run engine at 2000 min^{-1}.
Spark-advance angle must "advance".

Has spark-advance angle changed?

no

1. Test vacuum hose from EI control unit to throttle-valve-assembly plug-in connection for leaks. See lower illustration, arrows.
Eliminate leaks.

2. If no leaks were present, replace EI control unit.

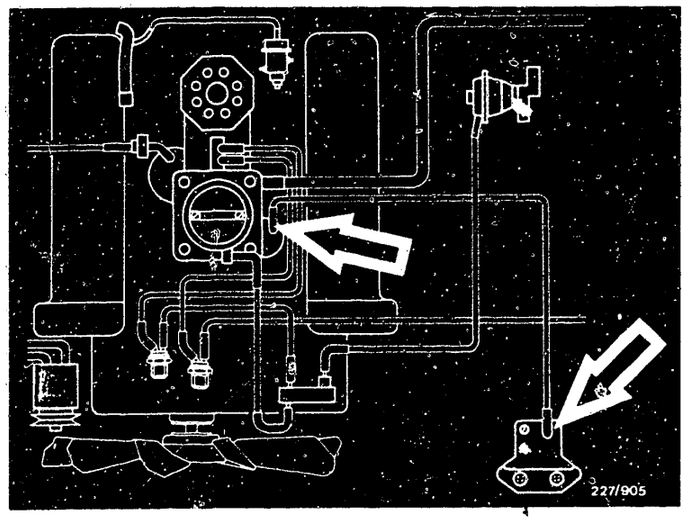


Vacuum hose

yes

Continued on M1/M2

Arrows = Vacuum connection, throttle-valve assembly and EI control unit



yes

Check the coolant temperature sensor.

Warm the engine up to normal operating temperature.
Connect the motortester to the diagnosis socket using an adapter lead.
Disconnect the vacuum hose at the electronic ignition control unit.
Disconnect vacuum hose from EI control unit.
See upper illustration, arrow.
Run the engine at 2000 min^{-1}. Take reading for timing angle.
Disconnect the coolant temperature sensor plug (color of cable green/black).
See Figure at the center, arrow.
Spark-advance angle must RETARD.

Did the timing angle change?

no

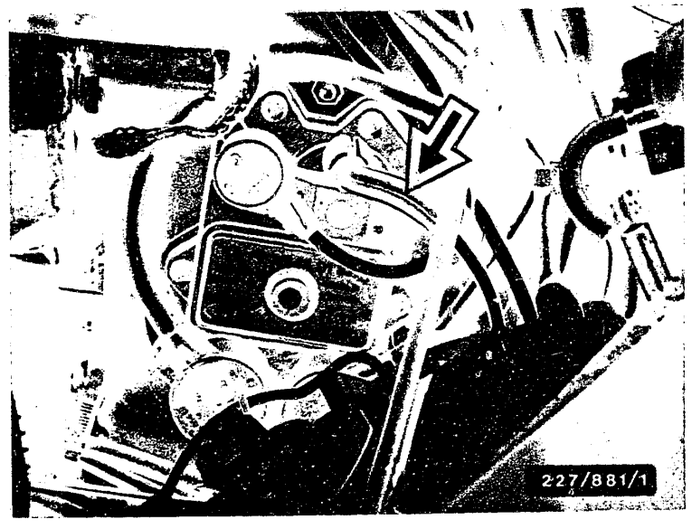
Switch the ignition off.
Disconnect the electronic ignition control plug and connect an ohmmeter to Term. 1 (Figure at bottom) and vehicle ground.
For resistances, see the table.

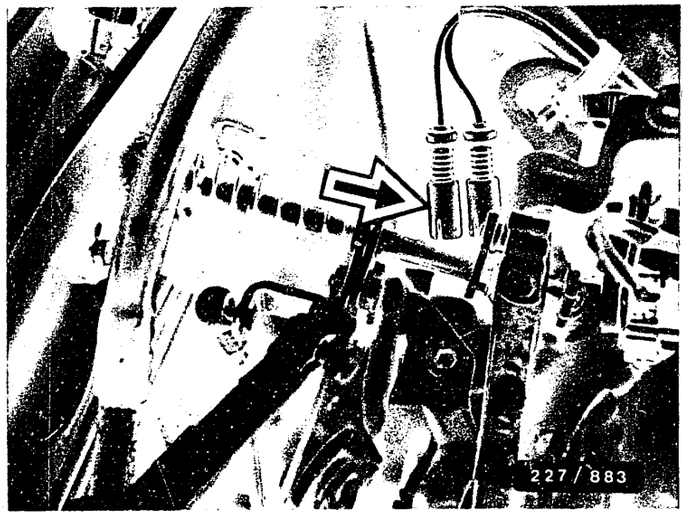
Coolant temperature		Resistance
+ 20°C	=	2.1...2.9 kΩ
+ 30°C	=	1.4...2.0 kΩ
+ 80°C	=	280...370 Ω
+ 90°C	=	210...280 Ω
+100°C	=	160...215 Ω

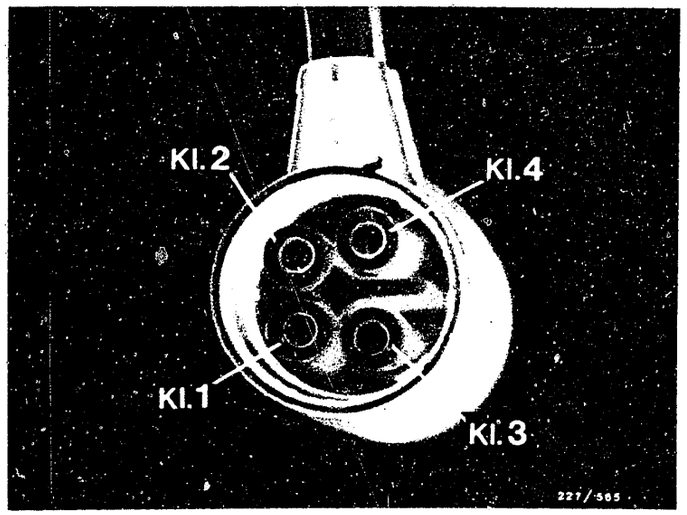
If the ohmmeter reads ∞Ω, then check the lead from the coolant temperature sensor plug (color of cable green/black) to the electronic ignition control unit plug Term. 1 for continuity. Eliminate any break. If the values for resistance deviate, take out and replace the coolant temperature sensor.

yes

Continued on M3/M4







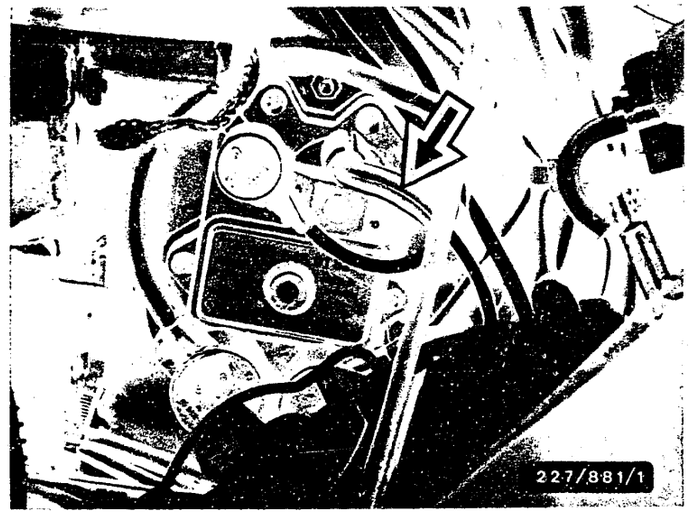
yes

Test spark-advance angle.
Engine is at normal operating temperature, but < 95°C coolant temperature (otherwise incorrect spark-advance-angle test specification).
Motortester with adapter lead is connected to diagnostic socket.
Coolant-temperature-sensor plug is connected.
Vacuum hose of EI control unit is disconnected.
See upper illustration, arrow.
Disconnect plug-in connection of throttle-valve switch.
See lower illustration, arrow.

yes

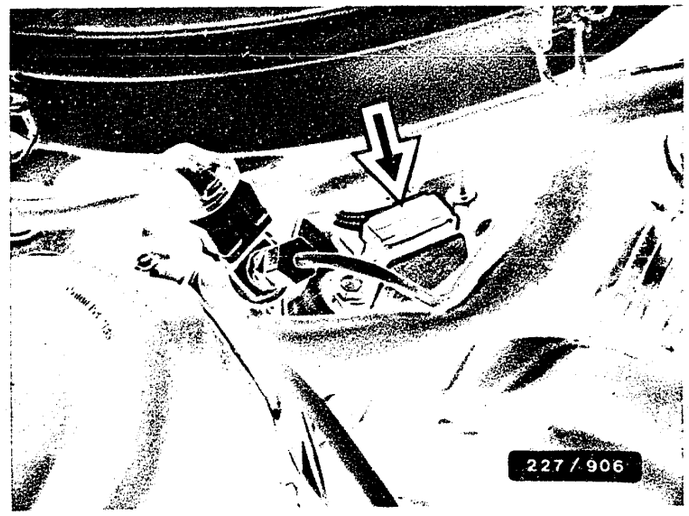
yes

Continued on M5/M6



Arrow = Vacuum hose

Arrow = Plug-in connection of throttle-valve switch



Spark-advance-angle set value for:

Vehicle WITH catalytic converter

Trimming plug EZL KAT (green)	Engine speed min^{-1} and ° crankshaft before TDC
Position S	3500 24 - 28 °
Position N	3500 18 - 22 °

Vehicle WITHOUT catalytic converter

Trimming plug EZL ECE (white)	Engine speed min^{-1} and ° crankshaft before TDC
Position S	3500 26 - 30 °
Position N	3500 20 - 24 °

Spark-advance angle O.K. according to table?

no →

Switch off ignition.
Disconnect EI control-unit plug and connect ohmmeter to term. 3 and vehicle ground.
See upper illustration.
Set trimming plug to positions 2 to 7 one after the other.
Poor resistance values, see table.
Note: The resistor network of all trimming plugs is identical. The trimming plugs differ from each other only with respect to their marking
EZL (white) or
EZL ECE (white) or
EZL KAT (green). See e.g. lower illustration.

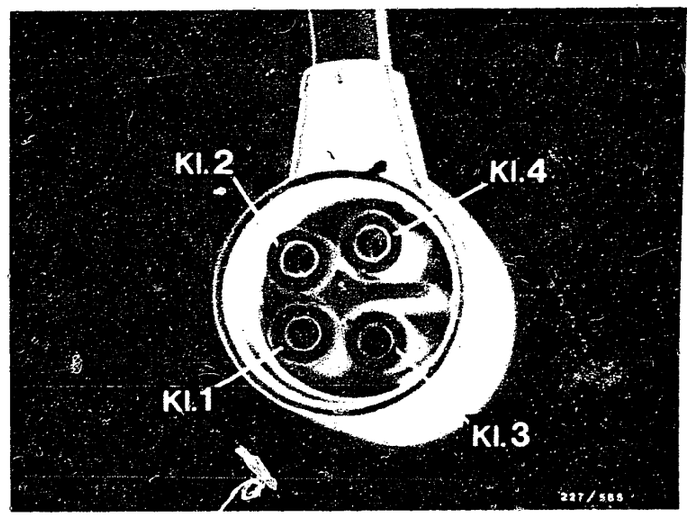
Trimming-plug position			Resistance value
*EZL	ECE	CAT	
1	S	1 =	∞ Ω
2	2	2 =	2.4 kΩ
3	N	3 =	1.3 kΩ
4	4	S =	750 Ω
5	5	5 =	470 Ω
6	6	N =	220 Ω
7	7	7 =	0 Ω

* For 220 kW engine only.

Yes ↓

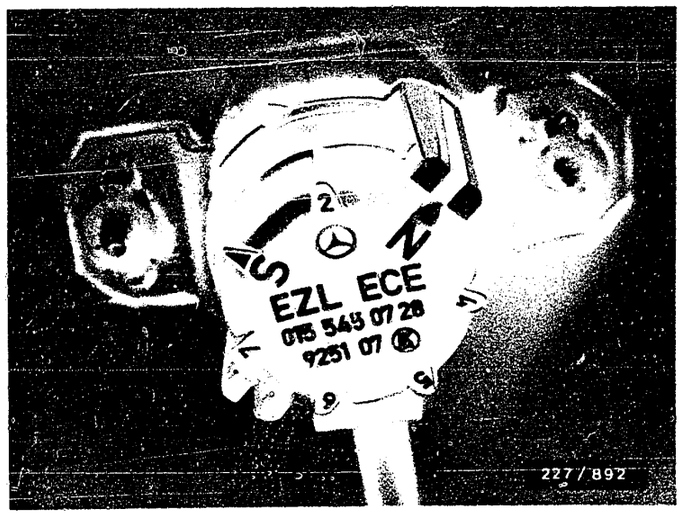
Continued on M9/M10

Continued on M7/M8



EI control-unit plug

Trimming plug
(e.g. EZL ECE)



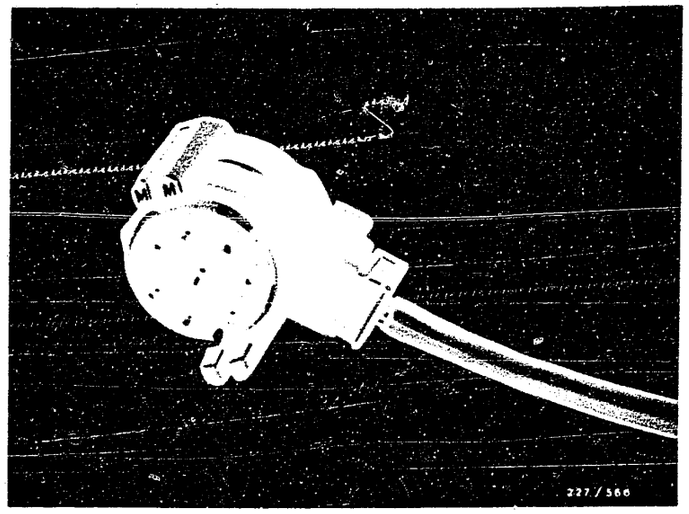
Continued

If resistance was O.K. in all 6 trimming-plug positions, replace electronic-ignition control unit.

If resistance was approx. 0 Ω or ∞Ω in all 6 trimming-plug positions, replace trimming-plug housing without trimming plug. See top picture.

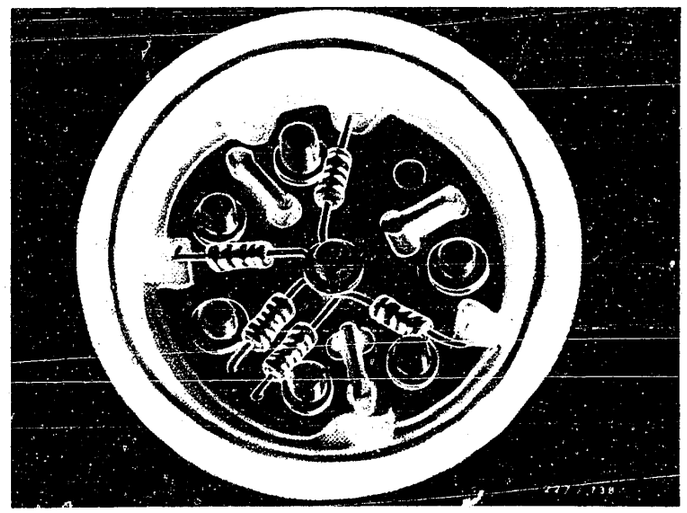
If resistance was not within tolerance, replace trimming plug. See bottom picture.

When the test is complete, reset the trimming plug to the specified "position".



Trimming-plug housing

Yes



Adjustment plug (from rear)

Continued on M9/M10

yes

Test <u>full-load contact of throttle-valve switch</u>.
1. Pull apart plug-in connection of throttle-valve switch.
See upper illustration.
Connect ohmmeter to plug-in connection term. 2 and term. 3 (throttle-valve side).
Ohmmeter must indicate ∞Ω in idle position and approx. 0 Ω (continuity) in full-load position.
2. Disconnect EI control-unit plug. See lower illustration.
Connect ohmmeter in turn to:

Throttle-valve-switch plug-in connection (wiring-harness end)		EI control-unit plug
Term. 3	and	term.2
Term. 2	and	vehicle ground

Ohmmeter must indicate approx. 0 Ω (continuity).

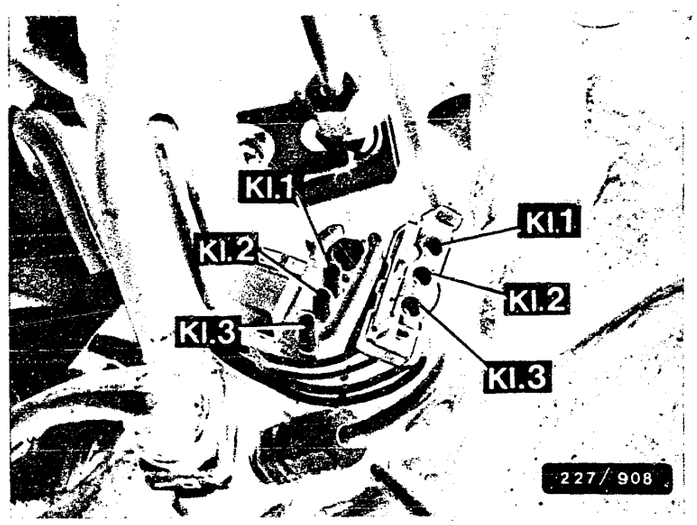
Resistance values in test steps 1 and 2 O.K.?

no →

<u>Test step 1</u>
If resistance value was not O.K., replace throttle-valve switch.

<u>Test step 2</u>

Test lead from throttle-valve-switch plug-in connection (wiring-harness end) term. 3 to EI control-unit plug term. 2 and from throttle-valve-switch plug-in connection term. 2 to vehicle ground for open circuit.
Eliminate open circuit.

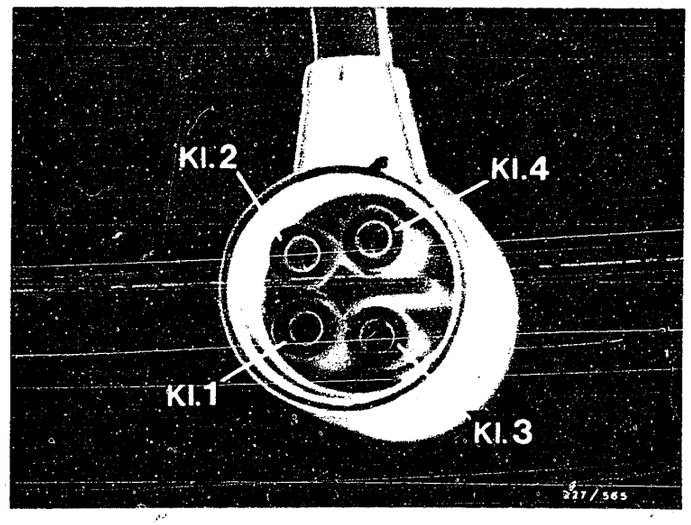


Plug-in connection, throttle-valve switch

yes

Continued on M11/M12

EI control-unit plug



yes

Check the voltage supply to the electronic ignition control unit and the ignition coil.

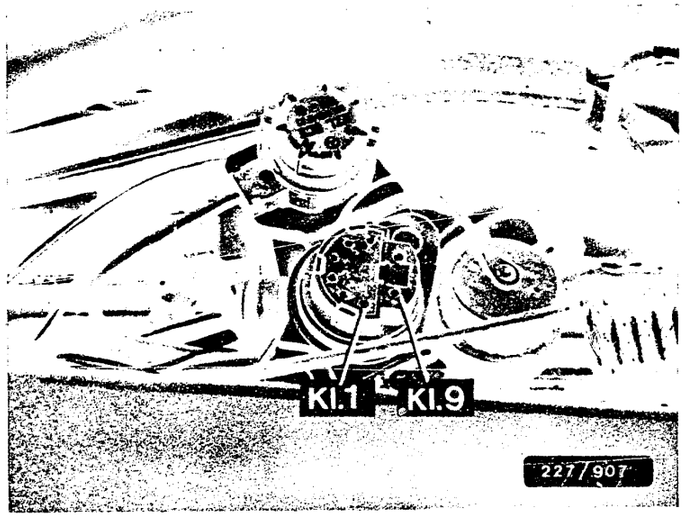
Connect the voltmeter and test prod to the diagnosis socket Term. 5 (+) and the battery terminal (-). See the Figure.
Run the engine at idle.
The voltage measured must be 12 ... 14 V and must not be more than 1 V less than battery voltage.

Is the value for voltage O.K.?

no

Disconnect the positive lead from the battery. Switch the ignition on. Check the leads from the positive battery terminal to the ignition coil Term. 15 for contact resistance.
Max. contact resistance 0.3 Ω.
(Take the resistance of the test lead and the test prods into consideration.)

Eliminate any contact resistance.



Diagnosis socket

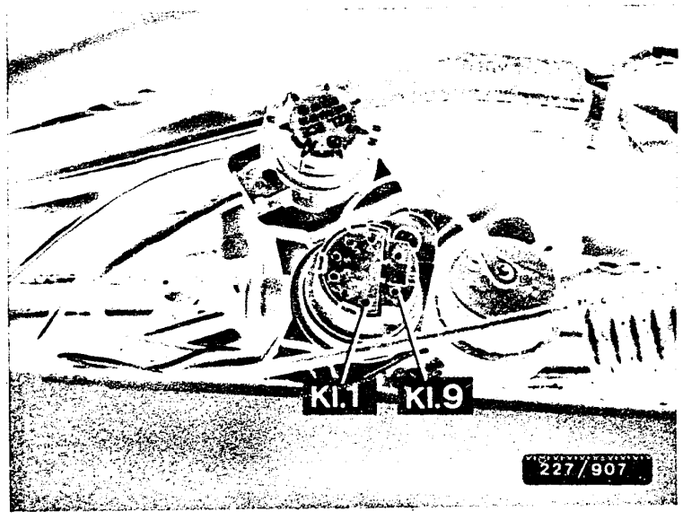
yes

Continued on M13/M14

yes

Check peak-coil-current cut-off.
Connect voltmeter with test prods to diagnostic socket term. 5 (+) and term. 4 (-).
See picture.
Switch the ignition on. For approx. 1 sec. the voltmeter can move a short distance.
The voltmeter must return to 0 V.
Is the value for voltage (0 V) O.K.?

no → Take out and replace the electronic ignition control unit and the ignition coil.



Diagnosis socket

yes

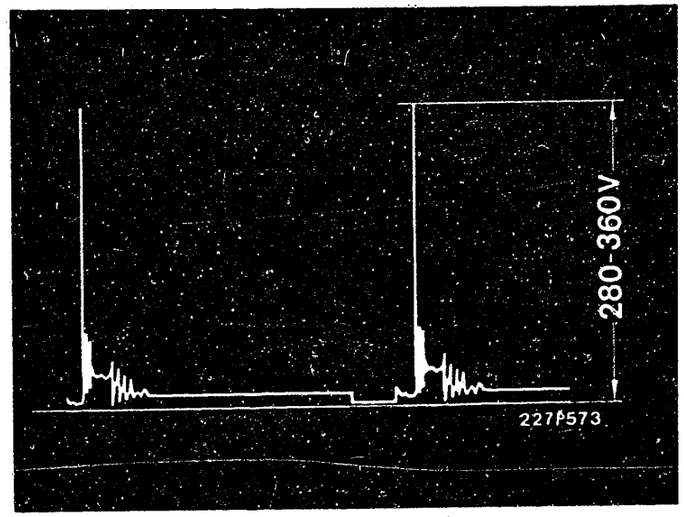
Continued on M15/M16

Check primary voltage.

(If MOT series available).
Connect oscilloscope (e.g. MOT 201) together with pulse shaper 1 684 463 154 to ignition coil as per operating instructions.
Note: Incorrect reading without pulse shaper. Operate engine at idle.
Measured primary voltage must be 280 ... 360 V.
See graph.

Voltage correct?

no → Replace EZ control unit.



yes

If all test steps were O.K. and customer complaint not yet eliminated, try installing specified new ignition coil.
If customer complaint still not remedied, re-install "old" ignition coil.
Ignition system O.K.
Testing completed.
Tests starting on M17 not necessary.

Note:
Further possible faults on fuel system or engine not mechanically O.K.

No primary voltage or no ignition spark.

(Continued from L9/L10)

yes

Check insulation of pulse generator.

Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 7 and the battery terminal (-). See the Figure at the top. The ohmmeter must read ∞ Ω . Is the value for resistance O.K.?

no → If the value for resistance is approx. 0 Ω, take out and replace the pulse generator. See the Figure at the bottom.

yes

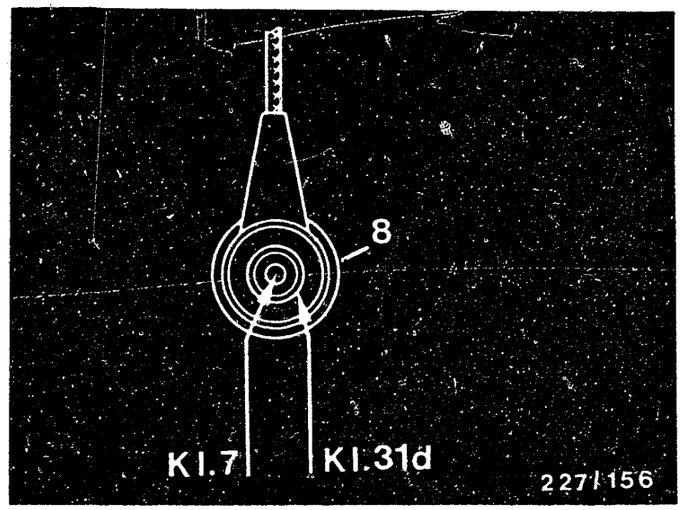
Check the internal resistance of the pulse generator.

Disconnect the electronic ignition control unit plug and connect an ohmmeter to Term. 7 and Term. 31d. See the Figure at the top. The ohmmeter must read 680 ... 1200 Ω. Is the value for resistance O.K.?

→ Take out and replace the pulse generator. See the Figure at the bottom.

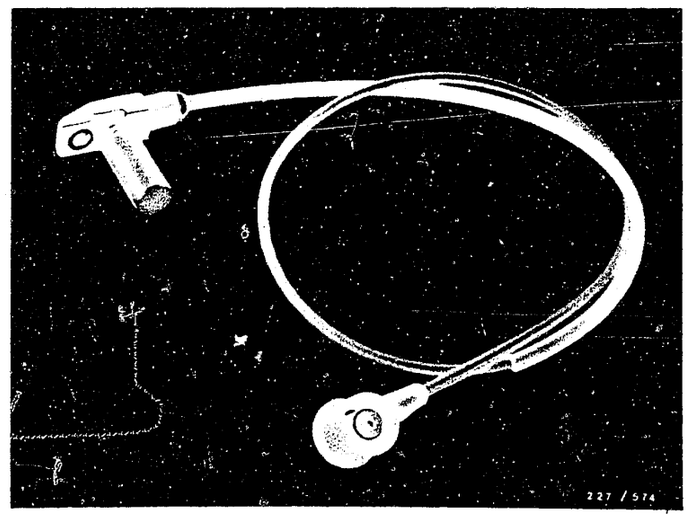
yes

Continued on M19/M20



8=Electronic ignition control unit plug - pulse generator

Pulse generator

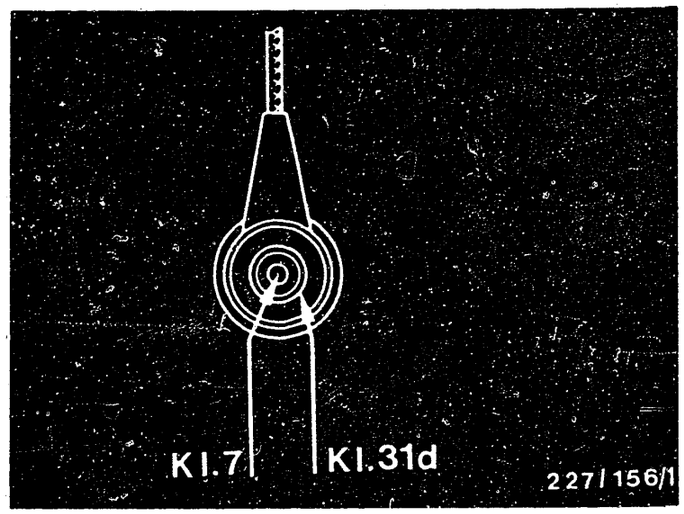


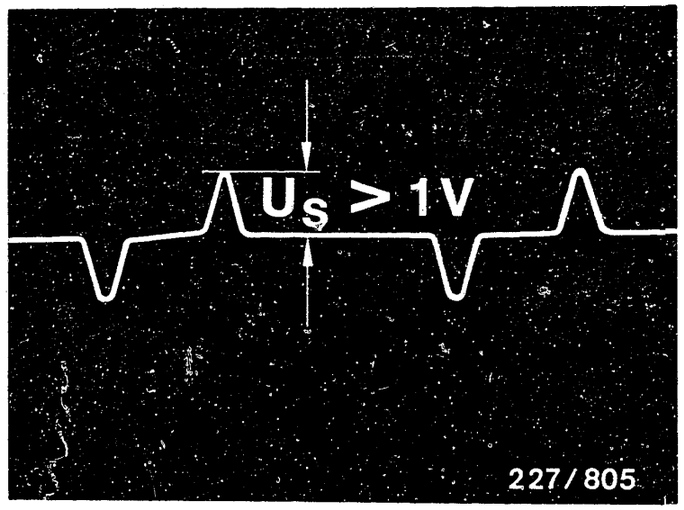
yes

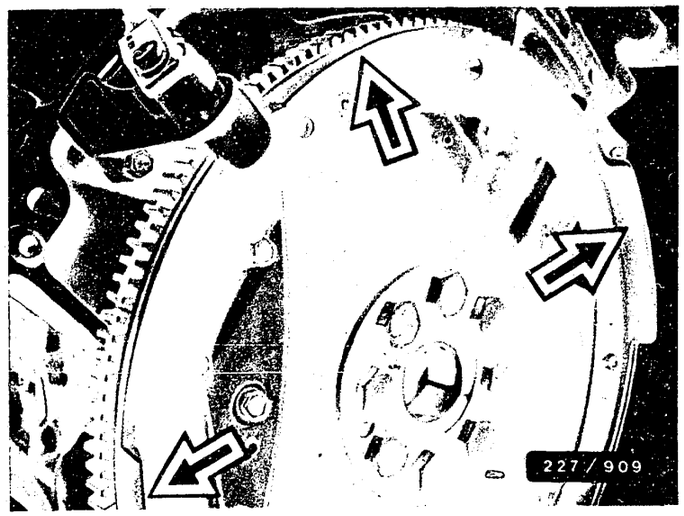
Check pulse-generator voltage.
Connect oscilloscope as per operating instructions with program switch in "special" position.
For example, MOT 201:
Connect red and black clamps to disconnected EZ control-unit plug term. 7 (+) and term. 31d (-). See top picture.
Start engine.
Oscilloscope must indicate a voltage of at least 1 V.
See center diagram.
Voltage correct?

no →

Remove pulse generator and check for mechanical damage.
Using screwdriver, turn the engine over from the starting-motor ring gear (opening, transmission bell housing) and at the same time check the 4 segments on the driver disc through the pulse-generator bore for mechanical damage.
See arrows, lower illustration.
Replace mechanically defective parts.
If pulse generator and segments mechanically O.K., replace pulse generator (electrically defective).







yes

Continued on M21/M22

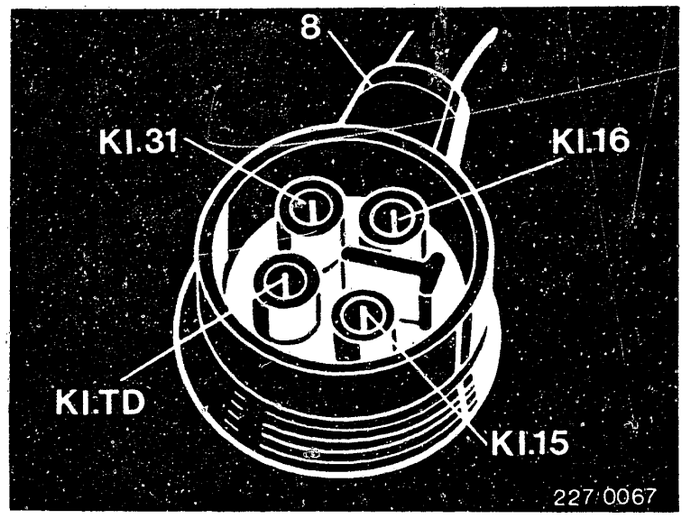
yes

Check the voltage supply to the electronic ignition control unit.

Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 15 (+) and Term. 31 (-). See the Figure.
Switch the ignition on.
The voltmeter must show battery voltage.

Is the value for voltage O.K.?

no → Check the leads and connections from the ignition and starting switch to the electronic ignition control unit plug Term. 15, including the ground lead Term. 31, for a break. Eliminate any break.



8=Electronic ignition control unit plug

yes

Check the primary circuit.
Disconnect the electronic ignition control unit plug and connect a voltmeter to Term. 16 (+) and Term. 31 (-). See the Figure.
Switch the ignition on.
The voltmeter must indicate battery voltage.

Is the value for voltage O.K.?

no → Check the supply lead from the ignition and starting switch to the ignition coil Term. 15, the primary winding of the ignition coil, and the lead from the ignition coil Term. 1 to the electronic ignition control unit plug Term. 16, including the ground lead, Term. 31, for a break. Eliminate any break.

yes

Continued on M23/M24

yes

Check ignition coil.

Remove protective cap from ignition coil.

Ignition coil, primary (term. 15 and term. 1)
0.20 ... 0.40 Ω (take resistance of test lead with test prods into account).
Ignition coil, secondary (term. 1 and term. 4)
7.3 ... 13.2 kΩ.

Resistance O.K.?

no → Replace ignition coil.

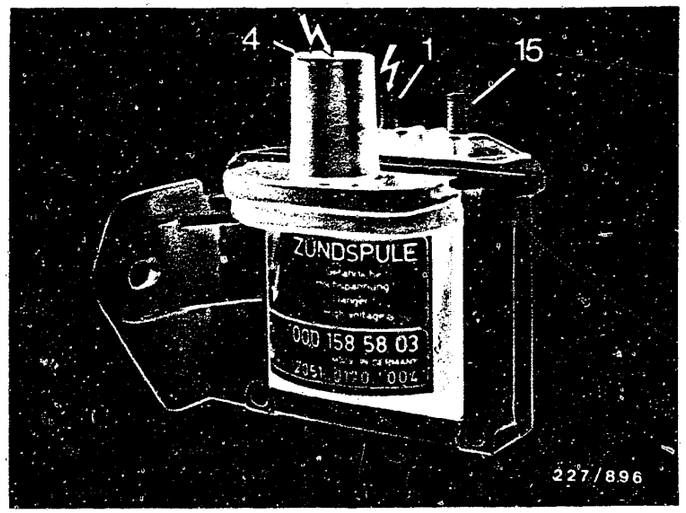
yes

If all test steps were O.K. and still no primary signal/ignition spark, try installing a new specified ignition coil.
If primary voltage/ignition spark still not present, re-install "old" ignition coil and replace EZ control unit.

Testing completed

Tests from L 11 not necessary.

Note:
If customer complaint still not remedied, further possible faults on fuel system, or engine not mechanically O.K.



Danger arrows:
Warning: 400V ... 25 kV

After-sales Service

Technical Bulletin

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22

VDT-I-227/102 B

11.1976

Danger of Accident on Semi-conductor Ignition Systems

Please be sure to pass this bulletin on to your employees for their attention.

The increased demands made on their ignition systems by modern engines, and the wish for freedom from maintenance, led some time ago to manufactures starting to equip their vehicles with semi-conductor ignition systems as original equipment. In most cases the performance of nearly all makes of such systems is higher than that of conventional systems, and further improvements are to be expected. This means that semi-conductor ignition systems have reached the point where contact with "live" parts or contacts (whether on the primary side or the secondary side) can prove fatal.

In this connection we should like to point out to you that the laws valid in your country regarding work on high-voltage systems must be adhered to when working on, or testing, semi-conductor ignition systems.

As a matter of principle, when working on such ignition systems the ignition is to be switched off. Included in such work are the following operations:

- Connection of engine testing equipment (timing light, dwell-tach tester, ignition oscilloscope etc.).
- Replacement of ignition system parts (spark plugs, ignition coil, ignition distributor, H.T. ignition cables etc.).

If it is necessary to switch on the ignition in order to test the system or make adjustments on the engine (to the carburetor for instance), then lethal voltages are present throughout the entire system.

This means that the danger of accident exists not only at individual components in the system (e.g. ignition distributor, ignition coil, trigger box, ignition harness), but also at the wiring harness (e.g. connection for the tachometer, diagnostic connector), on terminals, and on test equipment.

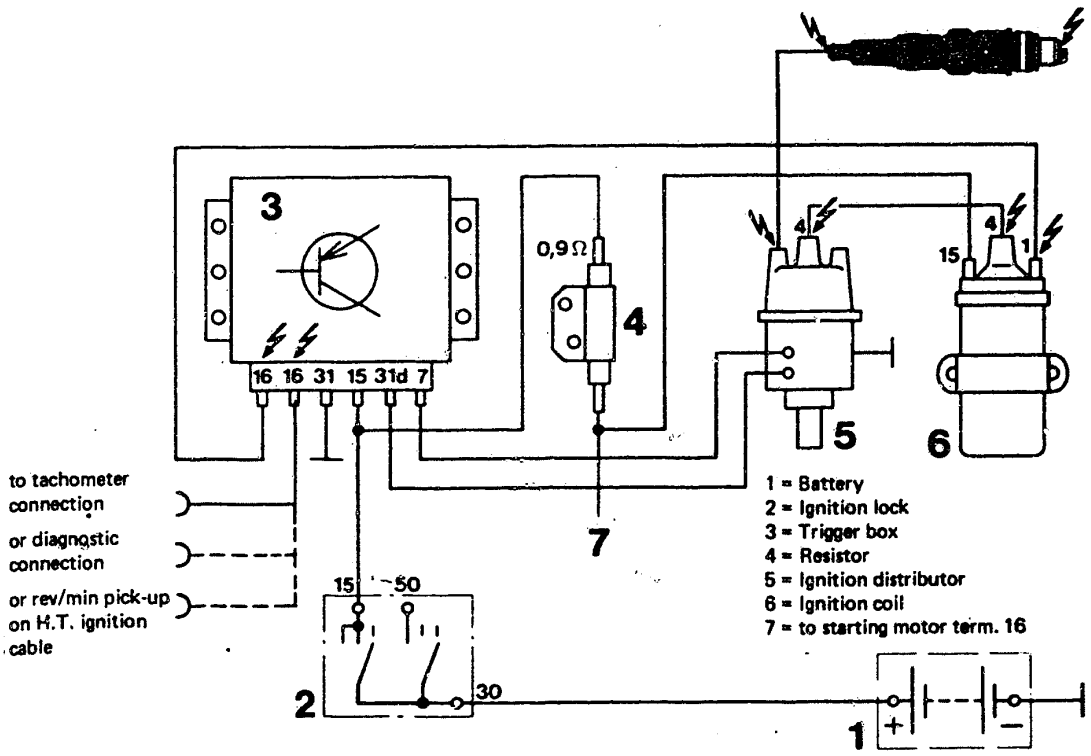
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In addition, in the case of the capacitor-discharge ignition system (CDI), danger of accident is also present under the following circumstances:

- Operation of the trigger box without the ignition transformer.
- At the trigger box, (removed), relatively soon after it has been switched off (capacitor discharge).

Below is a typical terminal diagram of a semi-conductor ignition system, the danger points are marked with red high-voltage arrows. We would point out that all semi-conductor ignition systems, even the older ones, are to be regarded as dangerous in the sense as defined by this bulletin.

Please address any queries or comments concerning the contents of this publication to our representative in your country.



Terminal diagram

After-sales Service

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EFFECTS OF ELECTRICAL AND ELECTRONIC SYSTEMS ON HEART PACEMAKERS

e.g. ignition systems, Jetronic, Motronic, ABS

VDT-I-227/107 En
1.1981

Please ensure without fail that this Bulletin is passed on to your employees for their attention!

We have often been asked by some of our customers whether or not patients with heart pacemakers are endangered in any way by ignition systems. This theme was recently the subject of an examination carried out by the Ignition System Development Department of Robert Bosch GmbH in conjunction with Dr. Thull, lecturer at the Central Institute for Biomedical Technology at the University of Erlangen-Nürnberg and Biotronic GmbH & Co. of Berlin, a manufacturer of heart pacemakers. The magazine "Biomedizinischen Technik" (5/80) listed the results.

The most important discoveries in this practice can be summarized from the examination report as follows:-

1. Heart pacemakers corresponding to the latest state of the art are not affected by radiation (electromagnetic fields) from ignition systems.
2. With a stationary engine and the ignition switched off the heart pacemaker is not affected by any part of the ignition system, even when unintentionally touched. Maintenance work in the engine compartment, for example, can then be carried out without any danger.
3. With the engine running or stationary with the ignition switched on, touching current-carrying parts of the ignition system, as well as parts of any other electrical system, presents a certain danger for everybody. The heart pacemaker can here be affected under certain conditions (voltage, current and frequency).
 Patients with heart pacemakers should therefore at all costs avoid touching current-carrying parts of electrical systems.
4. Furthermore, patients with heart pacemakers are more inclined to psychic shock effects than other people, even when they receive just a harmless electric shock, because many such patients are conscious of the increased danger to the cardiac activity.

We therefore consider it inadvisable for patients with heart pacemakers to be employed in workshops or on vehicles where ignition systems are being tested or repaired. If any members of your staff have heart pacemakers please carry out the necessary measures.

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We would like to add that heart pacemakers are not expected to be affected in any way by interference from other electronic products and systems which we manufacture, such as the Antiskid System (ABS), Jetronic, Motronic, because the much greater radiation intensity of the ignition systems examined in normal use has not caused any interference to heart pacemakers corresponding to the latest state of the art.

If you should receive questions on this matter from customers, please inform them accordingly.

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NEW DESIGNATIONS FOR IGNITION SYSTEMS

VDT-I-227/108 En
1.1983

The introduction of new ignition systems has made it necessary to reclassify all designations.

The designations listed below will be used immediately in KH workshop and sales literature.

Designation	Abbrev'd code	Meaning	Switching	Ignition control and spark advance	High-voltage distribution
Coil ignition	SZ (CI)	---------	Mechanical (breaker points)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Transistorized coil ignition	TSZ-K (TCI-c)	K=breaker-triggered	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Trigger box with conventional circuit techniques	TSZ-I* (TCI-i)	I=Induction-type pulse generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
	TSZ-H	H=Hall generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
Transistorized ignition	TZ-I* (TI-i)	I=Induction-type pulse generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)
(Trigger box in Hybrid technique)	TZ-H* (TI-h)	H=Hall generator	Electronic (trigger box)	Mechanical (ignition distributor)	Mechanical (ignition distributor)

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Designation	Abbrev'd code	Meaning	Switching	Ignition control and spark advance	High-voltage distribution
Breakerless semiconductor ignition with or without knock control	EZ EZ-K	- K=Knock control	Electronic (trigger box or control unit)	Electronic (control unit)	Mechanical (ignition distributor or high-voltage distributor)
Distributor-less ignition with or without knock control	VZ VZ-K	- K=Knock control	Electronic (control unit)	Electronic (control unit)	Electronic (dual-spark ignition coil, or 1 ignition coil for each spark plug)

*Note: The ignition system can also be equipped with a DLS unit (digital idle stabilization) or with an ELS unit (electronic idle stabilization) or with an ESV unit (electronic ignition retardation).

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INCORRECT DISPLAY OF ROTATIONAL SPEED AND DWELL ANGLE ONLY WITH TRIGGER BOXES 0 227 100 ... (TCI-i, TCI-h) WITH CURRENT LIMITATION

VDT-I-Gen. 030 En
6.80
Supersedes Ed. 3.80

For additional information see VDT-I-Gen. 032 En

1. General

In comparison with conventional ignition systems, transistorized ignition systems with current limitation have different primary voltage characteristics. During the dwell period the voltage at terminal 1 of the ignition coil may assume values from 1.5 V to battery voltage (or greater). This may lead to an incorrect display of rotational speed and dwell angle when testing the ignition system. However, there is no functional defect in the ignition system, and, for this reason, the trigger box must not be replaced. Incorrect displays may occur with the testers listed below:

MOT	001.00 001.01 001.02 001.04 002.00	Rotational-speed display O.K. with these testers	KTE	001.00 001.02 001.03

By now, the following vehicles may be fitted with breakerless ignition systems with current limitation:

Audi	(Bosch/Fairchild-ignition system)	Mazda	(Mitsubishi ignition system)
BMW	(Bosch ignition system)	Mitsubishi	(Mitsubishi ignition system)
Citroen	(Delco ignition system)	Nissan-Datsun	(Hitachi ignition system)
Fiat	(Delco ignition system)	Peugeot	(Bosch ignition system)
Ford	(Delco ignition system)	VW	(Bosch/Fairchild ignition system)
General-Motors	(HEI-ignition system)	Bosch transistorized ignition system for retrofitting 0 227 100 920	

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2. Test instructions

2.1 Rotational speed

Incorrect rotational-speed display can be recognized as follows:

If one starts at the idle speed and slowly increases the engine speed, then the incorrect display can be recognized by an abrupt reduction in the rotational-speed display (e.g. from 2400 min^{-1} to 1200 min^{-1}).

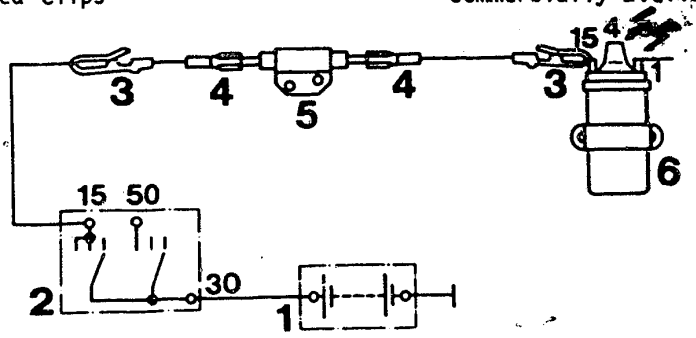
It is, however, possible to attain correct rot.-speed measurements as follows:

Connect a ballast resistor of 0.9 or 1.0 Ohm (see Fig.) in series in the line to term. 15 of the ignition coil (take care not to cause a short circuit). After the rotational-speed measurement, the ballast resistor must be removed (otherwise starting difficulties and misfiring). Connect tester as per operating instructions.

Suggestion for user manufacture

Required parts:

1 ballast resistor 0.9 Ohm	Part No. 0 227 900 002
or	
1 ballast resistor 1.0 Ohm	Part No. 0 227 900 101
2 blade receptacles e.g.	Part No. 1 901 355 881
approx. 0.2 m cable, 1.5 mm^2 e.g.	Part No. 6 210 150 150
2 insulated clips	Commercially available



1 = Battery
2 = Ignition switch
3 = Clips
4 = Blade receptacle
5 = Ballast resistor
6 = Ignition coil

↯ approx. 400 V

approx. 25 kV

2.2 Dwell angle

The dwell angle is electronically controlled. A measurement of the dwell angle is no longer performed.

2.3 Ignition point

Is displayed correctly. Connect tester as per operating instructions.

After-sales Service

Motor Vehicle Service Information

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MOTORTESTER CONVERSION
Incorrect display of rotational speed, dwell angle and ignition point only with trigger boxes 0 227 100 ... (TCI-i, TCI-h) with current limitation

VDT-I-Gen. 032 En
6.80

For additional information see VDT-I-Gen. 030 of 6.80

Re.: Motortester EFAW 268
268 S 10
269
214 B
AE 2000

1. General

Please make sure that the above-mentioned motortesters in your workshop and at your customers (e.g. motor vehicle workshops, oil companies, gas stations, vocational schools etc.) are converted. The conversion is subject to payment and is carried out by the K7 after-sales service of the responsible BG. The standard time is 15 work units (with fitting of switch).

2. Why motortester conversion?

In comparison with conventional ignition systems, transistorized ignition systems with current limitation have different primary voltage characteristics. During the dwell period the voltage at terminal 1 of the ignition coil may assume values from 1.5 V to battery voltage (or greater). This may lead to an incorrect display of rotational speed and dwell angle as well as to incorrect triggering of the meter when testing the ignition system. There is, however, no functional defect in the ignition system, and, for this reason, the trigger box must not be replaced. Since, with the above-listed motortesters, the timing light is triggered by the signal path dwell angle - meter, this incorrect triggering also leads to incorrect flashing and thus to an incorrect display of the advance angle.

3. Conversion measures

The situation is to be remedied by modifying the wiring of the testers so that the timing light is triggered by the clamp-on induction pickup and the pulse shaper stage.

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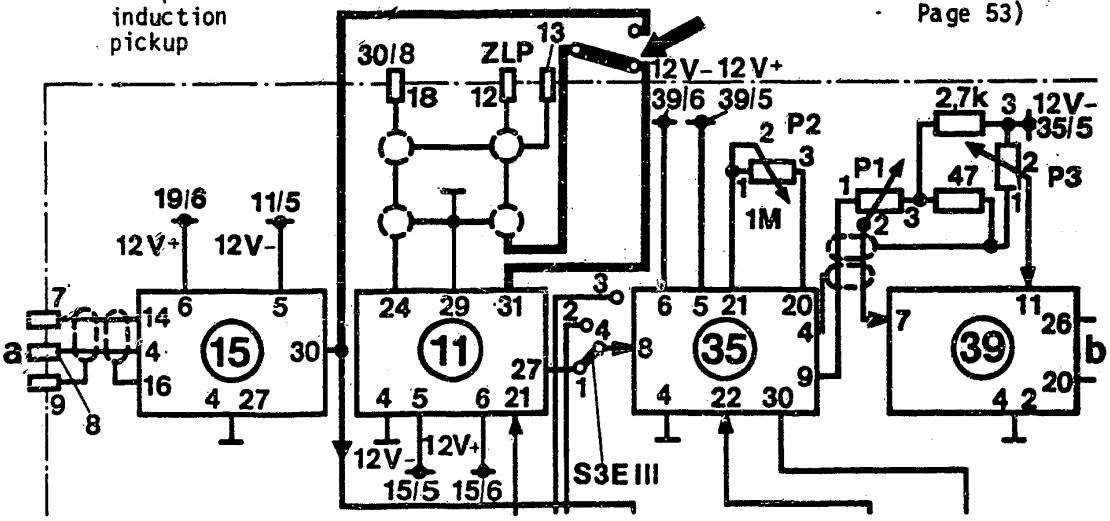
EFAW 268, 268 S 10, 269, AE 2000

Remove the line of the ZLP* from pin 31 of printed board 11 (coupling stage) and connect to pin 30 of printed board 15 (pulse shaper stage) via a switch with change-over contact (e.g. 0 341 500 803). In addition, a new line must be connected from pin 31 of printed board 11 to the other contact of the switch with change-over contact. Arrow points to switch with change-over contact.

* ZLP = timing light

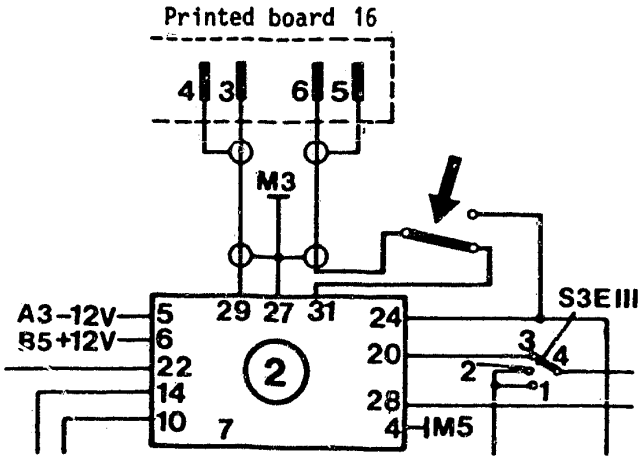
a = Clamp-on induction pickup

b = (Extract from WJF 508/1 Page 53)



EFAW 214 B

Remove the line from terminal 6 of printed board 16 to pin 31 of printed board 2 (coupling stage) and connect to pin 24 of the same printed board via a switch with change-over contact (e.g. 0 341 500 803). In addition, a new line must be connected from pin 31 of printed board 2 to the other contact of the switch with change-over contact. Arrow points to switch with change-over contact.



(Extract from WJF 503/1, Page 64)

By fitting the switch with change-over contact in the front panel of the motor-tester, it is possible to switch over from standard ignition systems to those with current limitation. We recommend that the switch positions be marked correspondingly: e.g. "standard" - "current limitation".
These conversion measures have already been published in the K7 information sheet KJF 28/7911.

4. Test instructions

4.1 Standard ignition systems

Switch position: "standard"
All other tester connections as per operating instructions.

4.2 Ignition systems with current limitation

Switch position: "current limitation"

In order to trigger the timing light, the induction-type pulse generator (clamp-on pickup or red pickup) must always be connected during the measurement.

The selector switch for ignition systems built into the motortester must be switched to standard coil ignition (not to TCI) with these ignition systems.

All other tester connections as per operating instructions.

The dwell angle is electronically controlled. A measurement of the dwell angle is no longer performed.

After-sales Service

Motor Vehicle Service Information

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TESTS ON ELECTRONIC IGNITION SYSTEMS
(TCI, TZ)
TESTER INSTRUCTIONS

VDT-I-Gen. 035 En
3.1981

The following tests are listed in older and current Tester operating instructions or in Trouble-shooting with the oscillograph.:

- "Separate ignition coil test" (concerns EFAW 213, 214, 268, AE 2000).
- Calculating the "ignition voltage reserve" (concerns EFAW 213, 214, 268, AE 2000 and MOT series).
- "Intensified insulation test" (concerns EFAW 213, 214, 268, AE 2000 and MOT series).

Nowadays transistorized ignition systems deliver more than 30,000 V secondary voltage.

To avoid damage to ignition coil, ignition cable and ignition distributor by voltage flashovers, the tests listed above should not be carried out on transistorized ignition systems.

The contents of this Service Information has already been published in the K7-Information K7-VJF 17/8012.

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Automotive Equipment - After-Sales Service,
Department for Technical Publications KH/VDT,
Postfach 50, D-7000 Stuttgart 1.

Published by: After-Sales Service Department for Training and Technology (KH/VSK). Press date: 7.1988

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Microfilmed in the Federal Republic of Germany.
Microphotographié en République Fédérale d'Allemagne.